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INDIAN ENGINEERING.

SATURDAY, JANUARY 7, 1928.

AFFLUX AT SUKKUR.

WE made some comments on Mr. Bellasis' attack on Mr. Woods on the subject of the afflux likely to be caused by the Sukkur barrage in a recent issue; and since then, in "The Engineer" of 11th November, Mr. Woods has himself replied to Mr. Bellasis' letter in a way that was to have been anticipated. He says that he will be pleased to deal with any statements which Mr. Bellasis can support with facts or figures that can be definitely grasped and verified or refuted, but that it would be futile to pursue speculative generalities that lead nowhere. In other words, he does not heed Mr. Bellasis' solemn oath, as the little London boy said, he wants to see his ha'penny; and that, after all, is commonsense. A letter such as that in which Mr. Bellasis indulged cuts no ice and only leads to bad feeling, which is not the way in which technical discussions should be conducted. Regarding Mr. Bellasis' declaration that the velocity of approach would be 13·2, Mr. Woods says that if he will state his authority for this figure or show by what process he has arrived at it, he will demonstrate that it is wrong. That is a fair challenge and, without taking any sides on the ultimate issue, it would be interesting to know how Mr. Bellasis calculated his figure and how Mr. Woods is going to prove it to be inaccurate. In no other manner are counter-arguments going to be conclusive. Then, as regards the afflux, the Sukkur project engineers calculate that the maximum afflux at the barrage will be less than 1 foot, that the backwater effect of this will diminish at the outfall station, 6,100 feet upstream, to 4 or 5 inches, and that it will vanish altogether before reaching the Bhakkar gorge, 3 miles upstream of the barrage, and so not affect the conditions of flow there. Mr. Bellasis, on a previous occasion, appeared to be of opinion that the project engineers were correct as regards the afflux at the barrage and at Bhakkar, though he reckoned that at the outfall station the backwater rise would be 0·88 feet. But now he puts the afflux at the barrage at 1·34 feet and at the Bhakkar gorge 0·75 feet, which is not in accord with the calculations of the Sind engineers. There is further the point of the standing wave formation, which Mr. Bellasis contends cannot occur. But it is not proposed to add to what Mr. Woods has said as pertaining to it, as it would answer no useful purpose. The gist of the matter is that Mr. Woods has studied exhaustively the whole project, and has thrown, in our opinion, much valuable light on many of its aspects which require serious consideration. His paper read at the Royal

Society of Arts was a very complete exposition of all the major points of the scheme and, again in our opinion, it is the best essay on the subject that has yet appeared. What has Mr. Bellasis done, can he say that he has studied the thirteen volumes of the project, or whatever the exact figure may be, in the same thorough way? If not, his views cannot be held to command the same respect. It has been shown that, except in one almost negligible feature of the scheme, the barrage is not required, and that to build a barrage of immense expense for that one feature is not sound sense. Mr. Bellasis has done no more than to seek to show that the barrage will not assail the safety of the Indus, but no one has said the barrage is bound to cause an avulsion, though it has been said that it is a possible danger, which is a different thing; and if it is a menace it is not desirable to court it for the sake of expending a huge sum of money, when the improvement of irrigation in Sind can be arrived at in better and less costly ways.

THE VERANDAH.

ON the 21st November last, Sir Herbert Baker read a paper on the Government Offices of Pretoria and the New Delhi before the Royal Institute of British Architects. At both these places, as is well known, the offices were designed by Sir Herbert, he was therefore well-qualified to speak of them, and from the fact that he gives any subject with which he deals a certain scholarly charm, his paper was a very attractive one. A feature of the evening would, however, appear to have been a speech by a member of the audience of long residence in India, in which he took the verandah as his text. Sir Herbert Baker had in his lecture given a lead in that respect. He said that in the design of the Pretoria building he had not given continuous verandahs, and had given only moderately thick walls, and rooms not very high as rooms are wont to be in the tropics, on account of the climate of Pretoria, where altitude counterbalances latitude. Pretoria is about the same distance from the equator as Delhi, but at Delhi, due to the greater heat, greater precautions were taken. There also, in the design of the Secretariat is a feature, unusual in the tropics and plains of India, in the absence of continuous verandahs. It was held that verandahs, especially on the east and west were only effective if made so low as to darken the room, and that heat radiates slowly from and clings to verandahs. Sir Herbert Baker was of opinion that walls, if thick and hollow, would keep out the heat, and would, if uncovered, quicken the radiation; and further, as far as windows were concerned, louvred shutters would keep the sun off the glass and facilitate the regulation of the light in the rooms. Sir Herbert admitted that complaints were made during the hot season, but contended that it was not for the great heat of the hot weather that the buildings were designed. It was with reference to remarks of this nature that the speaker, to whom we have alluded, took up the cudgels.

Never, he said, in the history of British occupation in India had there ever been a building scheme of the magnitude and expense of that of New Delhi. It was the latest thing; it was not, as far as the architecture was concerned, a Public Works affair; the architecture was in the hands of architects; and at New Delhi, if anywhere, it would have been thought that the buildings would have been something almost beyond criticism. But nowhere in the Indian Empire had residences built for officials been so severely criticised. The British architect in India, unless he happened to have had a fairly lengthy experience, was liable to overlook the climatic and other conditions of the country. In England he had not been accustomed to think in terms of verandahs, he may have in his home designs put in a verandah here and there, possibly calling it a loggia, because it suited the effect it was desired to produce; but a verandah as a matter of course interfered with his preconceived ideas, it found no favour in his eyes even in the case of a one-storeyed building, and when there were several storeys he shrunk from a design of continuous verandahs as leading to the effect of a bird-cage. But in India people have the verandah habit, and the verandah means a great deal to them. It is there that the *darzi* sits, and the *memsahib* will eternally have an eye on him; and there will be others there too, *chuprassis*, *munshis* possibly, visitors who may have to await their turn to be interviewed, itinerant pedlars displaying their wares; if there are children the children will be playing there, the domestic dogs will be watching from a coign of vantage for the squirrels; the verandah is in fact indispensable, and it is there, in shelter yet with the outlook into the open, that the life of the establishment is conducted. In front is, may-be, the tennis lawn, and in the verandah is the tea, as well as refreshments more potent than tea, and there will be gatherings of friends for social intercourse. At the first burst of the monsoon, the verandah comes into special prominence. The previous weather for some little time has been intolerable, the closed house has been an oven, it has not been too hot to drink but too hot to eat, not too hot to lie down but too hot to sleep; and then in the distance comes the roar of heaven's artillery, the wind brings clouds of grit, big drops of rain smack into the dust like rifle bullets, and then the deluge. It becomes a pleasure to throw open the doors to admit the cooler air, to sit or stand in the verandah to greet the downpour, and drink in great gulps of vitality, and watch the grass growing to the chorus of the frogs. In India that is a moment of which no one would like to be deprived. The title of Colonel Bowlong's book, "Told in the Verandah," shows, moreover, where all the best tales are told, of course they are told there; and then the speaker, noticing that there were ladies in the audience, said that they might be interested to know that besides tall stories something else was told in verandahs, nearly all the proposals of marriage were made there. There were more proposals made in verandahs, in the gloaming,

in the dark, in the sitting-out time between dances, than in all the other circumstances of life put together; in fact it might be true to say, "no verandahs, no wedding-bells."

The speaker continued to say that all that applied more to residences than to offices, and for the verandah-less residences of New Delhi, he believed that Sir Herbert Baker was in no way responsible. But even in the case of offices, verandahs offered many conveniences which could not be replaced by other means. He agreed that, as far as heat was concerned, hollow walls with sealed cavities could be designed to exclude heat as effectively as verandahs, but louvred windows would not afford as cool a room as windows screened from a greater distance. Shutters would exclude light, but not heat. Regarding the matter of radiation, of which Sir Herbert Baker spoke, the speaker said that if verandahs are provided with top ventilation, they induce circulation of air, and the protected walls thus give off the heat they have absorbed as readily as walls unprotected by verandahs. He admitted that if New Delhi was to be occupied by the Government of India for only three and a half months or so of the cold weather, the question of heat was not of very great consequence; but a time might be coming when it would be occupied for a longer period, in which case the present complaints would be intensified. The question of the hill-migration was one of old date, as long ago as 1851 Lord Dalhousie was sore of the attacks of the Indian press on his enjoyment of "cool leisure" in the hills, when his fellow-subjects were sweltering in the plains. Lord Dalhousie was one of the most unsparing of hardworkers and never enjoyed any leisure at all, whether in hills or plains, but so it was; and when the Lieutenant-Governor of Bengal, during his stay at his summer resort, fell over the *khad* and injured himself, the Indian papers broke out into a pæan of rejoicing, they said that if he had only remained at Calcutta he would not have fallen over a precipice. It may, therefore, be that some time or another there will be a longer stay at Delhi than has in the past obtained. But whether that ever came to pass or not, the speaker hoped that the distinguished architects of a great Institute, whenever they had to design buildings for India, would remember what he had said about the verandah and all that it meant to the dwellers in that country. He trusted that he would not be thought irreverent if he paraphrased a sentence of Scripture, he was thinking of one of the most beautiful chapters of the Bible, in which St. Paul, speaking in a spiritual sense, exhorted those whom he addressed to remember three important things, faith, hope, and charity, the greatest of which is charity. In India, architecturally speaking, there are also three important things, beauty, utility, and the verandah, and the greatest of these is the verandah. It was a stirring speech, the sort of speech that is bound to keep an audience attentive, but the main point about it was that it conveyed a moral which architects would do well to remember.

ROADS *VERSUS* RAILWAYS.

THE increased and still increasing volume of motor traffic has automatically called prominent attention to the question of roads. It would probably be fairly correct to say that nowhere at any period have roads ever been too good, as a rule they have always lagged behind the requirements, often very considerably, and improvements have come slowly, often very slowly, when the circumstances made neglect almost a scandal. But in all the history of roads in past times, there has never been anything so startling as the traffic conditions of recent years. Self-propelled vehicles, once their possibilities and advantages came to be realised, multiplied at an extraordinary rate, and the large number of such vehicles, with their weight and their speed, cut to pieces the roads which had previously been considered good enough. They were no longer good enough, they were hopelessly out of date, and to meet the altered conditions they had to be constructed in other ways and at an alarming cost. The road question therefore became one of the greatest of engineering problems, and in turn it led to another. Assuming that it is the bounden duty of any civilised Government to maintain the highways of the country it governs in a fit state for the needs of the new instruments of locomotion, every move in that direction brings still more traffic on the roads, a greater weight of loads, more speed, and by the fact that the roads come to possess so much more carrying power, they are brought into conflict with the railways. In that position some action must before long become emergent.

Railways are no longer in the same impregnable situation that they were, for the transport of heavy goods over long distances they have still no rival, but with sufficient roads and good roads motors can carry a great deal and they have the advantage that they can convey goods direct from producer to consumer without breaking bulk. The competition of the roads can therefore hardly help having an effect on the railways and the subject has of recent years been warmly discussed in England. Moreover, at the World Motor Transport Congress, opened in November, Colonel Ashley, Minister of Transport, stated that the Government, which had previously held aloof from the discussion, had awakened to the necessity of an enquiry into the present state of affairs. In that connexion, "The Times Trade and Engineering Supplement" makes some very pertinent remarks. It says that if road maintenance and development are charged to public funds, there is no escape from the conclusion that road transport is subsidised to the disadvantage of railways which in addition to meeting the cost of upkeep of their own tracks, are compelled to contribute by rates and taxes to the upkeep of a competitor. Railways are at present prevented by statute from establishing competitive systems of road transport, as they cannot act as carriers of goods apart from the railways, and if they were given statutory powers of competition, the road transport companies would complain of a monopoly which would not be in the interests of the common weal. But, as "The Times" says, it is impossible to

ignore the immense sums of money invested on the railways, and the country cannot afford to see this vast amount of capital become non-productive, nor contemplate with equanimity any decline in the railway services due to poverty.

The problem which has thus been brought to the front by the new means of locomotion is not, if both parties are to be satisfied, easy of solution; but if there is good-will on both sides, it should be possible to arrive at a system of co-operation, and it is only by co-ordination that a wasteful and cut-throat form of competition can be avoided. India may not at present feel that she is very much concerned, the roads of the country are not yet in a state to permit of active competition with the railways, and the distances are very much greater, but the Railway Board will doubtless feel that it is incumbent on them to take necessary action before the question assumes an acute form.

A NEW MAGAZINE.

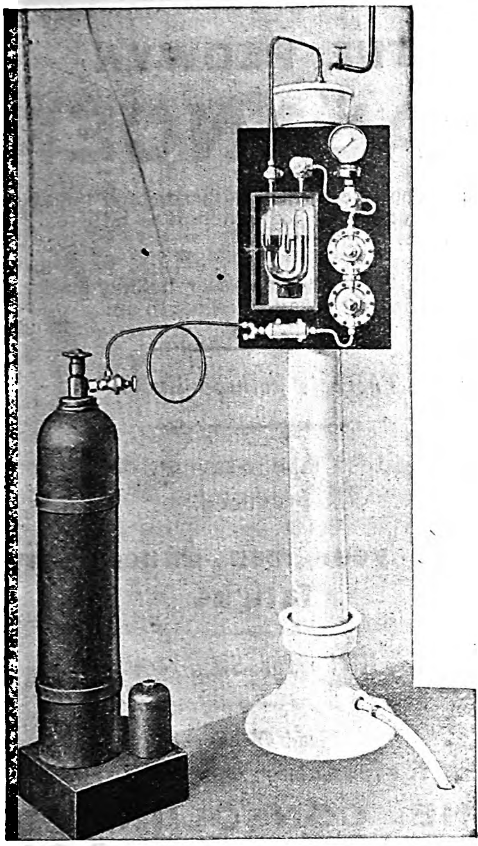
As more and more of the railways of India are brought under State management, they become an increasingly big affair, but already four of the most mportant railways are State managed, and the occasion has been taken to found an "Indian State Railways Magazine," the first number of which issued in October, last. The aim of the periodical is to represent this group of railways, and by bringing all employees in touch with one another to create and develop a feeling of co-operative interest. One-third of the pages will apparently be devoted to local gossip and domestic news and events of all kinds, but there will also be educative and railway technical articles, fiction and light articles. The venture has, it is said, the patronage of the Railway Board, and Sir Clement Hindley, the Chief Commissioner of Railways, is taking an interest in it. The frontispiece of the first number is a portrait of His Excellency the Viceroy, Lord Irwin, P. C., G. M. S. I., G. M. I. E., who has written a very pleasant welcome. He says :—

> "I welcome the opportunity afforded by the publication of the first number of the 'Indian State Railways Mazagine' to send a message of greeting to Indian Railwaymen.
>
> India, a country of great distances, of dense population, and of immense natural resources is dependent, more perhaps than any other country in the world, on the provision and maintenance of good communications. On the men who build and work her railways a great trust is imposed, and from what I have seen since I came to India I believe that this trust is safe in their hands.
>
> The ideal, which they have before them, of service to the public and to their country, is one which demands self-sacrifice, devotion to duty and co-operation between all ranks, and I hope that future years will see the constant maintenance of the high traditions that the Indian Railways have established.
>
> IRWIN."

These stirring words are a happy augury for the future of the publication, and the first number is an excellent one. There is an article "On Permanent Way" by Mr. R. V. Hitchcock; Mr. Arthur L. Stead discourses on "The World of Railways"; Mr. E. Rosenthal writes on "Peeps from a Railway Carriage Window"; "Safety First" is a useful article on the subject of the avoidance of railway accidents; and there are some good Notes on railway matters. Mr. E. J. Buck has an article on "Shooting in the Simla Hills," a subject of which he has had long experience, and Mrs. F. A Steel contributes a capital story by way of fiction. A tribute is paid to Mr. A. E. L. Harrison, Assistant Controller of Stores, G. I. P. Railway, who has retired from the Stores Department of this railway. He has held charge as Acting District Controller, Jhansi Depôt, for close on eight years, and was given a hearty send-off prior to his return to England after an absence of forty-six years. It is stated that Mr. Harrison's reason for not visiting his native land before was he had experienced such bad weather on his first voyage that he could not endure the thought of another. Yet, he elected to start for home in the height of the monsoon. The Magazine has our good wishes for its success.

ANTI-MALARIAL WORK ON THE SARDA CANAL.

THE annual Public Health Report of the United Provinces of Agra and Oudh for the year 1926-27 comments on the anti-malarial measures taken at the site of the head-works of the Sarda Canal. Banbassa is an unhealthy spot where mosquitoes appear to flourish in the swamps around, and action had to be taken to promote, as far as possible, the well-being of the labour camps. The action apparently taken was that of clearing large areas of jungle, excavating and maintaining drains, and periodical silt and weed clearances, and oiling. Whatever was done in that way was not from the statistics very efficacious, but in November 1926, the commencing month of the working season, the use of Paris-green was begun. This was introduced first in 1921 and was reported on by Hackett at the International Malaria Congress at Rome in October 1925. It is said that it proved an effective larvicide when thrown from aeroplanes travelling over swamps. Paris-green or aceto-arsenite, it is explained, should be bought containing not less than 50 per cent. of arsenic. For use it should be mixed with dust, wood-ashes, lime or sand in the proportion of 1 of Paris-green to 100 of the diluent. The mixture is thrown into the air and thus carried over marshes and waters it is desired to attack. The strength noted above is sufficient except where there is much surface scum. The tendency has been to use too much rather than too little. The larvicide is equally good when used on running water or stagnant pools, and it has no effect on culex larvæ, fish, cattle or human beings, it can therefore be used in wells, stock and cattle ponds. The only precaution to be observed is that the man who is spreading it should stand to the windward and should wash his hands before taking food. Jungle clearance is not necessary before applying the Paris-green, and the report says that it is now proposed to use Paris-green to the exclusion of almost all other larvicides in future. In none of the Public Health Reports do we find any reference to bats, and if they had the efficiency ascribed to them as mosquito destroyers, the International Malaria Congress would surely have had something to say on the subject.



This apparatus has received the HIGHEST AWARD at the Royal Sanitary Institute's Health Exhibitions each year since 1919.

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Notes and Comments.

Railway Development.—The Railway Board have sanctioned a reconnaissance survey being carried out by the agency of the Eastern Bengal Railway Administration for a line of railway to connect the eastern end of the extension of the Bengal Duars Railway with the southern end of the Cooch Behar Section of the Eastern Bengal Railway near Gitaldah, a distance of about 50 miles.

"Burn's Engineering Magazine."—Our thanks to Messrs. Burn and Co., Ltd., for a copy of the 21st Anniversary Number of their magazine. It is an especially good number, full of most interesting reading and information. The magazine is one which is always looked forward to and perused with great interest, and is a most welcome addition to our table. The present issue does great credit to both the editor and the publishers.

Concrete Aerodromes.—In American and German aerodromes large areas of concrete paving are being laid in front of the hangars to serve as runways on which the 'planes can land or take off in any weather. Berlin's "Croydon"—the Tempelhofer Flaughafen—is to have a new elliptical concrete starting track 977 yards across from north to south, and 1,300 yards from east to west. This track, it is anticipated, will enable a considerable economy to be effected annually in the upkeep of the aerodrome.

New Air Route.—According to the "Morning Post," the French International Air Navigation Company is considering extending its Constantinople Line to Cairo soon. The French Eastern Air Line, which has just been allotted a large grant by the French Government, recently sent its representatives to London to discuss certain details with the British authorities. It is anxious to extend its service across Syria and India to China. The French Air Union Eastern Lines Company, which is extending its services to Iraq and Cairo in co-operation with British Airways, hopes to make possible, and perfectly safe, a journey between Marseilles, Beirut and Cairo with hydroplanes capable of carrying three passengers and a ton of cargo. The Company intends to carry British mails for India and the Far East to a point on the Iraq frontier, where they will be transferred to Imperial Airways. The regular service begins in June.

The Pyramid Kennedy Formula.—Our contributor Σ. Φ. reports, for the information of all the Irrigation Departments of the World, that the Pyramid Composite Section is the key to a rational and improved "Kennedy" Formula for the critical mean velocity in earthen channels. For an explanation, the reader is referred to the articles: "Factorized Hydraulic Formulæ"; which appeared in our issues of the year 1925.

The P. K. Formula (short title) is :—

$$V_0 = C_0 \sqrt{f_\rho} \ \sqrt{y}$$

For V_0 in feet per second throughout, the values of C_0 are (subject to slight correction perhaps):—

Kennedy's Sections		C_0 =	1·201	log	·079358
Sind	...	,,	0·900	,,	9·954148
California	...	,,	1·400	,,	·146033
Madras	...	,,	0·806	,,	9·906535
Burma	...	,,	1·234	,,	·091227
Rio Negro	...	,,	0·986	,,	9·993913
Egypt	...	,,	0·660	,,	9·819297

Eastern Bengal Railway.—Among the several subjects discussed at the 38th meeting of the Local Advisory Committee of this Railway, presided over by the Agent, Mr. N. Pearce, on the 16th December last, were the following :—Overcrowding of trains during the return Puja rush and the Ishurdi-Pabna Bera or Sadhuganj construction. It was explained that though trains were strengthened to their maximum capacity relief specials were difficult to arrange for the return rush since the traffic was distributed, and not concentrated as in the case of the outward rush. It had been urged that the Ishurdi-Pabna construction should be extended to Bera or Sadhuganj. This question was to be re-examined. If it proved such extension to be remunerative, well and good, otherwise, it was suggested that the District Board who were pressing for the extension should be asked if they were prepared to guarantee the Railway against loss. In any case the Railway Board's reply to the revised report would be communicated to the Committee.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 22nd December 1927 :—Messrs. Ingersoll-Rand (India), Ltd., Calcutta—1 Drill Sharpener, complete will drill steel punch, Rs. 6,672 free delivery at Pathankot, *ex* stock ; 1 set Shanking Device for forming ¾ inch square shank 3½ inches long with collar 1½ inches diameter on ⅞ inch hollow hexagon drill steel, Rs. 2,880 free delivery at Pathankot, *ex* stock ; Messrs. Martin and Co., Calcutta—Spares for 300 Ruston Dragline Excavator, Rs. 37,000 c. i. f. Karachi ; Spares for 135 Ruston Dragline, Rs. 3,082 c. i. f. Karachi ; Jessop and Co., Ltd., Calcutta—2 Generating sets, 15 k. w., 600 r. p. m., 225—240 volts, driven by 24 b. h. p. engines, Rs. 83,390 free delivery at Ghazipore railway station by 15th March 1928 ; Messrs. Turner, Hoare and Co., Ltd., Bombay—1 Road Roller, steam, 12-ton, compound cylinder, complete with fittings and differential gear, Rs. 12,855 delivered free and under steam at Fort, Delhi, by 1st April 1928 ; Spare parts for Garret Roller, Rs. 1,858 free delivery at Isri.

The "Atkinson-Walker" Rail Tractor.—This is an innovation in locomotive design and construction, manufactured by Atkinson-Walker Wagons, Ltd., Preston, England, to which we would draw the special attention of Locomotive Superintendents, Colliery Proprietors, Quarry Owners, Civil Engineers, Public Works Contractors, etc. This Rail Tractor is a modern substitute for the century old locomotive. In these days when all commodities—coal especially—are expensive and labour costly, the merits of this novel, original, economical and simple Rail Tractor cannot be overlooked. Compared with the orthodox steam locomotive it contains many elements of superiority. It is constructed to suit any power or any gauge. The firm will gladly furnish drawings, tenders and specifications against enquiries in which full particulars are given of load to be hauled, speed on level, maximum gradient, gauge, etc. This Rail Tractor is manufactured for any rail gauge from two feet upwards and any power to 1,000 tons on level. A glance over the handsome illustrated brochure published by the firm will convince the most sceptical that in the "Uniflow" Engine, Indestructible Boiler, fuel less than half is expended and at a maintenance cost of one-tenth. This Rail Tractor is bound to prove a great success.

New River Mail Steamer.—We mentioned some time ago that the two Calcutta River Steam Navigation Companies were constructing new steamers for service on the Eastern Bengal rivers. The India General Navigation and Railway Company have just completed at their Garden Reach shipyard the S. S. "Emu," intended for the company's mail and passenger service between Goalundo, Chandpur and Naraingunge, carrying the Dacca and Chittagong mails from Calcutta in conjunction with the Eastern Bengal Railway. This new steamer is a side-paddle vessel of the latest type, and has accommodation provided for all classes of passengers. The "Emu" is 225 feet in length, and has ample accommodation for first, second, intermediate and third class passengers. The appointments for all classes are all that can be desired, for their comfort. Few are aware of the advantages of a river trip, but with steamers now offered, we think the riverside excursions will become more popular than ever. The writer is one who travelled up and down 21 years ago and highly values the changes that have been made. Although so far as first class passengers were concerned there was little to complain of. One could "eat the air" to the full, and it was delightful.

The Port of Liverpool.—On 5th December last the Gladstone Graving Dock at Liverpool, which, after being opened by the King in July 1913, was again closed in March 1921, to allow the full completion of the Gladstone Dock scheme, was reopened. A description of the dock and the pumping machinery was given in the "Engineer" of 22nd July last, in which article reference to earlier descriptions was made. The first vessel to enter the dock was the 18,940-ton White Star Liner "Albertic," which, after renovation, will be followed at intervals by the "Adriatic," "Megantic" and "Celtic," all of the White Star fleet. Another happening at the Port of Liverpool, which unfortunately has been attended with serious financial loss, was the stranding of the motor vessel "Lochmonar," of the Royal Mail Steam Packet Company, which, when entering port, went aground on the revetment, to the north of the Crosby Lightship. The "Lochmonar" was returning from Vancouver with passengers and a cargo of dried fruits. Happily both the passengers and cargo were transhipped and landed without difficulty. It is understood that the steering gear of the ship was found to be out of action, which, if confirmed, will account for the mishap. Efforts to refloat the vessel failed, and she broke her back with the ebbing tide. A temporary bulkhead has been built to fill the open space at the after part of the vessel, and it is hoped to salve that part of the ship by refloating it and towing it into dry dock. The "Lochmonar" was a 485 feet vessel of about 9,400 gross tons, and was propelled by twin-screw four-cycle single-acting oil engines, designed to develop about 4,500 shaft horse-power. She was built and engined by Harland and Wolff in 1924.

More Help for the Farmer.—Diesel engines are encroaching more and more for power purposes upon the realm previously covered by the steam engine. Last year, for the first time, statistics show that more motor ships fitted with Diesel engines were being built than steam engines. On the top of this comes the announcement from Messrs. John Fowler and Co. (Leeds), Ltd., that Diesel engines can now be used for ploughing and cultivating work instead of the steam ploughing engines they have been making for so many years. The advantages of the Diesel engine on the land are even more marked than at sea. Just as in a ship, the storage and handling of the fuel is simplified, and the Diesel ploughing engines can carry a sufficient supply to last them for three or four days. It is, however, in the matter of water supply that the motor engines score so heavily, as the steam engines cannot be built with condensers and need a constant supply of water to keep them at work. The lower fuel cost is, however, the feature which will appeal most to farmers, who are especially anxious at the present time to cut down their costs of cultivation. For ploughing 6 inches deep, the fuel cost for a Diesel ploughing tackle is only about *9d.* per acre, against *2s. 3d.* for similar work with petrol engines and *2s.* for the coal used in steam engines without including the cost of carting water. These figures apply to current costs in Great Britain, but a similar saving can undoubtedly be made in the majority of countries overseas. These new Diesel ploughing engines cannot be considered in any way experimental when the engine makers are the M. A. N. firm, who are the world's largest Diesel engine manufacturers, and the combination of their engines with Messrs. Fowlers world-wide experience in the building of heavy cultivating machinery should ensure the success of these plants from the very start.

Roads and Railways.—Lord Montagu of Beaulieu, always interested in roads transport questions, spoke with effect in the House of Lords on the important matter of competition between the railways and roads. He said that he had no hostility to the railways, and so far from objecting to their asking for an enlargement of their power, his only wonder was that they had not done it long ago. The position at present is that railway companies can run any road transport service they please, as long as it is in connexion with existing railway services, In England they have over 35,000 of their own vehicles using the roads, and are bigger than any other single transport organisation in the country. But they have to compete with great commercial undertakings conveying goods, and that form of traffic is bound to increase because it is cheap, more convenient, and quicker than railway transport. The outlook for railways is therefore not brilliant, while that for road transport is becoming brighter every year. The problem is therefore a difficult one, if railways are made legally entitled to accept for road transport traffic not originating on their lines, the competition would become too serious; and if not made so entitled, there might be so great a decline in railway revenue that railway freights would have to be increased and impose a burden on the general public. Lord Peel, who replied for the Government, said that the public interest was the over-riding principle in the question, which was a truism it was hardly necessary to utter. Everyone knows that, but the point is whether railways are to suffer and have therefore to charge higher rates, affecting the public interest, or are to be allowed to compete on equal terms with road companies, in which case the road companies will suffer and lead to public inconvenience. The Railway Board is no doubt watching the case, as one in which India will at some time be concerned.

Life of American Skyscrapers.—Sir Edwin Lutyens, R. A., one of the two eminent architects of New Delhi, is reported to have said that he estimated the average life of the American skyscraper at forty years. It sounds a little alarming, once upon a time tall buildings were spoken of in terms of the Pyramid of Cheops, the Washington Monument, and the cathedrals

of Ulm, Strasburg, St. Peters at Rome and the rest. But the old heights are nothing at all now, and modern commercial buildings have soared to elevations of which the human mind had never dreamed since the days of the Tower of Babel. Still, if skyscrapers are going to come down with a run after forty years, it would apparently give some food for thought. It may, however, be wondered what Sir Edwin meant exactly. He is a bit of a humorist, and did he mean that the thin walls of reinforced concrete insufficiently protected the steel from atmospheric action (we have yet to learn what the life of some reinforced concrete structures may be) or was he poking fun at the hustle and bustle of the United States. The great monuments of beauty that the world possesses, the beautiful cathedrals of Europe, our Taj Mahal of India, and other triumphs of the art of the craftsmen of a by-gone era were built for all time; and in quite another category and without the same reason the structures of the Public Works Department of India have been described as built for eternity, not for time. But then the affairs of the world are moving now at a rate which is confusing. America has had a five-year period of industrial prosperity of bewildering effect, and skyscrapers, however expensive they may have been in a country of high rates for labour, may not be wanted to last. New conditions, new machinery, the newness of everything coming on may call for new buildings, because old buildings, though only forty years of age, are out of date, and it may therefore be good business to dynamite them even if they do not fall down by automatic action. A tip-top motor car of the day is considered archaic in a few years, and rejected for the newest and best of the moment, and so, if America can afford it, let the skyscrapers go too for things newer and bigger. "Behold, I make all things new" is the present maxim.

"King George V" in the United States.—Considerable interest has been aroused, both in Great Britain and in the United States, by the presence at the centenary celebrations of the Baltimore and Ohio Railroad, held at Baltimore from 24th September to 8th October last, of the Great Western Railway locomotives "North Star" and "King George V," the former having been built in 1837, and the latter, of course, being the first of a new class recently designed by Mr. C. B. Collett, C. B. E., and built at the Swindon Works. After the conclusion of the centenary celebrations, the "King George V" was employed on a run in passenger service on the Baltimore and Ohio Railway, from Baltimore to Washington, thence to Philadelphia and back to Baltimore, the total distance covered in the three sections being 271·8 miles. The report on this run of the Baltimore and Ohio Test Bureau is reprinted in the current issue of the "Great Western Railway Magazine," from which we gather that the performance of the engine was regarded as particularly creditable by the officials present. The train consisted of three passengers coaches, two Pullman sleepers, an official car and a dynamometer car, the total weight hauled being 543·6 tons, and records were taken of drawbar pull, speed, boiler pressure, throttle opening and reversing-lever position throughout the whole of the run; no record of coal or water consumption was kept. The first section, of about 39 miles, from Baltimore to Washington, was completed in 58 minutes 45 seconds, actual time in motion, the maximum speed attained being 74 m. p. h. From Washington to Philadelphia, some 135 miles, the running time was 2 hours 56 minutes, and the maximum speed 73 m. p. h., while for the third section, of about 96 miles, from Philadelphia to Baltimore, the time in motion was 2 hours 14 minutes 50 seconds, and the maximum speed 69·3 m. p. h. Throughout the trip, no difficulty was experienced in starting or in hauling the load, although the fuel used, a hard gas coal for which the form of grate was not well suited, gave some trouble from clinkering. When it is remembered that Driver W. Young and Fireman G. Pearce, both of the Great Western Railway, were unfamiliar with the road and with the class of fuel used, it will be evident that some, at least, of the credit for the satisfactory performance of the engine is due to these two men—a fact which was fully acknowledged by the American officials. The latter commented particularly on the smooth-running qualities of the engine, as well as on its performance, workmanship and appearance. The engine has thus worthily upheld the high traditions of British locomotive engineering, and the reception accorded it by American engineers must be gratifying to the directors of the Great Western Railway Company, as it is also to British engineers in general.

Modern Methods in Tobacco Manufacture.—The utility of a perfectly uniform sheet of heat, sensitive to instant and graduated regulation, and arranged in such a manner that, being radiant, it may be projected in any direction, is clearly very considerable both for domestic and industrial purposes, and its scope is practically unbounded. By the system elaborated by Mr. F. J. Cox, and now being exploited by the Metropolitan Fuel Co., Ltd., of Westminster, London, all these conditions are achieved. Cox's Ignite Combustor has the appearance of a granulated brick; it is actually a porous refractory medium held in a cast-iron casing with a space between the back of the combustor and the casing, forming a chamber into which the mixture of air and gas is fed, and from which it passes through the combustor to its exposed surface, where it is ignited. The face of the combustor is then brought to a state of brilliant incandescence with a complete absence of flame. Any clean combustible gas will work with the apparatus, such gas being mixed with air in the requisite proportions. In the case of coal gas these proportions should be 5½ parts of air to 1 of gas. The pressures of both gas and air naturally vary with local conditions. The maximum temperature obtainable is something like 1,000 deg. Centigrade with gas and air under pressure. Since the combustion depends on a primary supply of air only, namely, that derived from a fan, which may be outside the premises, there is no need to impoverish the air of the room or workshop in which the apparatus is installed. As a commentary on this particular feature, it is interesting to quote the case of a large tobacco factory in the West of England. The local factory inspector was not satisfied with the atmospheric conditions round the drying pans, which in his opinion were injurious to the health of the workers. As a result Cox's Ignite Combustors were installed, and owing to the complete combustion secured no further trouble was experienced. A considerable number of sets have been supplied to leading firms of tobacco manufacturers for a variety of purposes. The British American Tobacco Co., for instance, adopted the system some four years ago in one of their factories for drying tobacco and soldering the tins, with the result that with regard to the soldering machines the output has been doubled, and it is probable that the system will be standardised for all this company's factories. Messrs. Carreras, Ltd., employing the system for a similar purpose, increased their output of tins by approximately 50 per cent., at

the same time effecting a saving of 30 per cent. of gas. They also found that, with the ordinary method of soldering their tins, it sometimes happened that some of the cigarettes themselves were scorched. After adopting the Cox system this was never known to happen, as by these means a constant and uniform heat is obtained, avoiding all risk of "spot" heating.

Assisting the Radio Listener.—The name of Ferranti, Ltd., of Hollinwood, Lancashire, has for years been synonymous with the manufacture of electrical apparatus and instruments, and it was not surprising, therefore, that, with the development of wireless the firm should have made full use of their long manufacturing experience and taken a leading position in the new industry. Thus, the Ferranti Radio programme for 1927-28, as anticipated by the recent National Radio Exhibition, held in London, is a very comprehensive one. The firm's various radio meters have a guaranteed accuracy of within 1 per cent. and are provided with non-metallic cases so that the possibility of shorting of leads through their touching the instrument case is removed. The voltmeters are available in two kinds, having resistances of 200 ohms and 1,000 ohms per volt, and even the lower of these figures is exceptionally high when compared with the resistances of other similar high-class instruments. A valuable feature of these instruments is the provision of a fuse which is easily replaceable by the user from the front of the instrument without disturbing it in any way, a spare fuse being included in the price of every instrument. The value of this innovation can hardly be over-estimated, as even the most careful experimenters are apt to make mistakes in connections sometimes, and these with ordinary instruments will have disastrous results. The 1,000 ohm per volt instrument is particularly useful in measuring the voltages of high-resistance circuits such as those of battery eliminators, when the current taken by the measuring instrument may appreciably affect the accuracy of the instrument reading. The Ferranti Trickle Charger is a very simple apparatus for charging accumulators at home from the alternating current mains, and employs a Westinghouse patent metal rectifier, no valve or chemicals of any kind being used. The unit is provided with four terminals, a negative and three others giving respectively voltages suitable for charging 2, 4 or 6 volt accumulators at the rate of ½ an ampere, when a plug, which is provided, is fitted in a lighting socket. Many sets consume about ½ an ampere, and in such cases the Trickle Charger will be left on for approximately the same time that the set is used, a simple procedure being to plug it into the lamp-holder on going to bed. The Trickle Charger itself may be left permanently connected to the accumulator, but the plug should be removed when listening as otherwise the hum of the mains will be apparent. Ferranti, Ltd., intend to manufacture a range of "push-pull" Transformers, as with the improvement in loud speakers and the necessity when obtaining really good reproduction for the lighter tones to be properly reproduced without overloading on the more powerful ones. This method of coupling again becomes very necessary, more especially as, notwithstanding Captain Eckersley's recommendations to use not less than 300 volts, such a pressure is apt to be dangerous, and voltages in excess of 200 should never be placed in the hands of the ordinary radio listener. "Push-pull" amplification thus becomes the solution of the problem as the finest reproduction is obtainable without excessive high tension.

Current News.

THE Saar iron and steel workers have come to terms with their employers and have resumed work.

MR. W. G. BURN, officiating Controller of Stores, East Indian Railway, has been granted leave for seven months.

FOUR new steamship berths and an elevator of 2,000,000 bushels capacity are to be constructed at St. John, New Brunswick.

THE Anglo-American Oil Company intends to utilise ground at Tweedmouth Dock for the purpose of building a large oil depôt.

LLOYD'S Register of Shipping has published a new set of rules for the building and classification of composite and steel yachts of the cruising type.

A PLANT for distilling wood is being put up at Borschum, South Russia. It will be capable of producing 50,000 kilos. of wood creosote annually.

THE Boekit-Assam Mining Company intends to start mining operations in a new coalfield in the Dutch East Indies, estimated to contain 10,000,000 tons of coal of very good quality.

THE total approximate gross earnings of State Railways up to 17th December amounted to Rs. 70·39 crores, or Rs. 317 lakhs more than the figures for the corresponding period of last year.

THE Government of India have sanctioned the construction by His Exalted Highness the Nizam's Government of a railway on the 3 feet 3⅜-inch gauge, from Parbhani to Purli, a distance of 38 miles.

THE municipalities in Northern Brabant met at Hertogenbosch on 12th December to discuss a scheme of long-distance gas distribution from the South Limburg Colliery district similar to that of the towns of Roermond and Venlo.

CONTINENTAL papers report the formation of a cast-iron combine, including the United States Cast Iron Pipe and Foundry Company, Burlington, N. J.; the Stanton Ironworks in England, and the Gelsenkirchener Gusstahl und Eisenwerke A. G. in Germany.

ACCOMPANIED by the Crown Prince, the King of Norway, on 1st December last, opened the first part of the so-called Soerland (South) Railway, which will connect Eastern Norway with Southern and Western Norway. The terminus of the first part is Krageroe.

THE total approximate gross earnings of State Railways for the week ending 17th December amounted to Rs. 219 lakhs, or Rs. 2 lakhs less than the figures for the last week, and Rs. 12 lakhs more than the figures for the corresponding week of the previous year.

A RECENT report of the Canadian Bureau of Statistics, Ottawa, shows that the total value of the pressed, blown, plate, cut and ornamental glass produced in the Dominion during 1926, was 11,670,269 dollars. The corresponding figure for 1925 was 10,117,604 dollars.

THE fifth of the seven sections of the large 50,000-ton floating dock for the new Singapore naval base, which is under construction for the British Admiralty, has been successfully launched from the Wallsend shipyard of Messrs. Swan Hunter, and Wigham Richardson, Limited.

IN the autumn of 1921 Mr. Gresley began the use of electric stoves for cooking in the kitchen car on the King's Cross and Leeds dining car train. There are now eight kitchen cars on the London and North-Eastern so fitted. The current is axle generated, supplemented from batteries when the trains are at rest in a station.

THE picture telegraph service between Vienna and Berlin was formally opened on the morning of 1st December last with the interchange of photographs of the Austrian and German Chancellors. The lowest tariff for a picture measuring 10 cm. by 4 cm. is 8*s.* That works out at 2·4*d.* per square centimetre, or about 1*s.* 3½*d.* per square inch.

GIVING evidence before the Royal Commission on the Australian Commonwealth constitution, Colonel Norris G. Bell, the Commissioner of the Commonwealth Railways, advocated the federal control of all the railways in the various states. He said that such a change would simplify the difficulties of obtaining uniformity in freights, fares and gauges, and effect large economies in many directions.

MESSRS. THOS. FIRTH AND COMPANY, of Sheffield, are reported to have made arrangements with the Bengal Iron and Steel Company for the manufacture of rust-resisting steel in India. On the other hand, the Tata Iron and Steel Company are negotiating with the American Rolling Mill Company, of Middletown, Ohio, U. S. A., for the acquisition of rights of manufacturing Armco iron in India.

THE management of the Austrian State Railways has decided to stop for the time being further electrification of its system, as the present low price of coal renders steam traction cheaper than electricity. It is also stated that the railways are now able to use inferior grades of coal, particularly for goods traffic. The cost of electric current is now higher than it was in the inflation period, while the price of coal is considerably lower.

NOTICE.

MESSRS. WALTER JUDD, LTD., Leith House, 47, Gresham Street, Bank, London, E. C. 2, will be pleased to afford any information regarding this Journal, which is undoubtedly the best medium for English manufacturers to make known their products in India, Burma, Ceylon and the Far East.

Foreign Notes.

New Thames Bridge at Marlow.—Marlow is to lose the iron suspension bridge which connects Buckinghamshire and Berkshire, for, according to the "Daily Telegraph," it has been declared inadequate to support present-day road traffic. The bridge, which was erected about 100 years ago, is to be demolished, and a new ferro-concrete bridge, faced with stone, is to be built in its place. The new bridge will have a single span, and it is estimated that the scheme for the demolition of the old bridge, and the construction of the new—which will take two years—will cost £70,000.

An Underground Electric Furnace.—According to the "Daily Telegraph," an electric furnace recently installed in South Africa is being worked at a depth of 6,300 feet, which is claimed to be the greatest depth at which such a furnace has been operated. It was designed by Mr. Verdon C. Cutts, managing director of Verdon Cutts and Co., Ltd. The furnace is to be used for the heating of carbon drill steel in furtherance of a growing movement to heat-treat drills underground. The old system of bringing the drills to the surface for treatment meant taking up several hours' hauling time a day and consequently holding up the recovery of rock.

Clayton Tunnel.—This tunnel, on the main line to Brighton, is 2,266 yards long. It was opened, as part of the section between Hayward's Heath and Brighton, on 21st September 1841, and when constructed a culvert was provided to carry off the water that enters the tunnel from numerous springs. The culvert was laid in the "six-foot," but at its widest part the sides reach to under the "four-foot" of both lines. With the growth of traffic it has been considered necessary to strengthen it and the work is now in hand. As a speed restriction of 15 miles per hour has been imposed, there must necessarily be delays to trains, and the Southern Railway has therefore given public warning accordingly.

Oil-electric Locomotives.—American manufacturers are experimenting with the construction of larger, more powerful oil-electric locomotives. One company was building in May 1927 an experimental 1,000 horse-power oil-electric locomotive, using a six-cylinder, four-cycle Diesel engine. A second manufacturer is working on a locomotive with a twelve-cylinder, four-cycle engine rated at 960 horse-power at 325 revolutions per minute. Three other companies are working on locomotives with a six-cylinder, four-cycle engine rated at 750 horse-power at 500 revolutions per minute. One railway company has designed a new type of Diesel locomotive and is building three of them in its own shops.

Converting a Canal into a Roadway.—The history of the old Erie Canal and the new Erie highway is a romance of modern transportation. To accommodate the ever-increasing number of cars appearing on the streets of Syracuse, U. S. A., it was decided to fill in for a distance of five and a half miles the canal which ran through the town and to lay a concrete road on the foundation thus formed. For four years this work has been in progress, and, in addition to completing the filling in, a two and a quarter mile stretch of concrete road will have been completed by the end of the year. Out of the bed of a sluggish waterway along which canal boats were hauled by equally sluggish mules is arising a broad ribbon of concrete on which motors will throb and pulse with loads of merchandise.

Oil from Coal.—In a lecture recently delivered to the German Industrial Society, Dr. Brueckmann, chairman of the German Coal Utilisation Company—which is working in close connection with the Dye Trust in coal liquefaction—described the rapid progress in the production of artificial fuel oil. Now that plant for the liquefaction of coal has been constructed in Germany on a large scale, Herr Brueckmann declared, the quantity of oil obtained per ton of coal had considerably increased. He calculated that between 650 and 700 tons of oil could now be extracted from 1,000 tons of coal. The placing of artificial oil fuel on the world's markets, which, he said, had been considered with Sir Henry Deterding in 1922, did not for the present come into question, but perhaps later those countries whose petroleum supplies became exhausted would be obliged to depend on the new process.

Smoke Abatement in Chicago.—According to the Chief Smoke Inspector of the city, Chicago has eliminated 90 per cent. of its smoke in the last five years. During and after the war, the industrial development, coupled with inability to obtain clean-burning coal, intensified the smoke nuisance in Chicago, but systematic and assiduous efforts have brought about a remarkable change. Chicago, we are told, is the only city in the world which states in its ordinance that chimneys may emit smoke only when the fire is being built up. If the aggregate of smoke exceeds three minutes in length of time, the owner of the chimney is liable to a penalty for violation of the ordinance. An appropriation for 31 mechanical engineers, experts in combustion, was granted by the Chicago Corporation, and these men visit the numerous plants and advise the owners. Railway boards deal separately with infraction of the smoke ordinance by locomotives.

High-Pressure Steam.—At a meeting of the Junior Institution of Engineers, in London, on 25th November, Mr. Loftus P. Perkins dealt with the subject of "Pioneers in High-Pressure Steam," relating some of the achievements of that inventive genius Mr. Jacob Perkins in the reign of George III, which were momentarily startling to many 1927 engineers. In these days, when a boiler engineer liked to work at pressures of 300 lb. per square inch and eagerly read about boilers designed for 3,000 lb. per square inch, he was apt to disregard passing references to steam pressures of 2,000 lb. per square inch being generated and used three generations ago. However, boilers and engines for really high pressures up to 2,000 lb. per square inch were made by Mr. Jacob Perkins and his descendants from the year 1822 onwards, and some of them had continued in operation until 1919. It was with a spirit which put modern ordnance activity to shame that the Duke of Wellington declined to make use of the Perkins' steam gun, capable of discharging musket balls at the rate of 1,000 a minute, on the ground that it was too destructive. The author exhibited a number of illustrations and mementos of the work of these pioneers, including a piece of copper tube, ⅛ inch internal diameter, which had been used to pass high-pressure steam capable of developing 40 h.-p. Other references were made to steam vessels like the "Emily," "Antracite," and "Salamander," which owe their distinguished place in the history of steam vessels to the Perkins family.

Controlling Beet Sugar Machinery.—A rather unusual development of the two-wire system of railway signalling came under our notice when making a recent visit to the Ely Beet Sugar Factory, says "The Engineer." A beet sugar factory has to be worked at high pressure during the four months of the "campaign," when the beet is being harvested and its sugar extracted, and although the remaining eight months of the year may be devoted to the overhauling of the plant, there is the possibility of some mishap or other occurring during the running period. Apart from the risk to the operators which may result from such a mishap, the whole process may be disorganised. It is therefore essential, that in the case of emergency, the working of the plant may be readily controlled to meet the exigencies of the occasion. At the Ely factory such provision has taken the form of several "frames." made by the Westinghouse Brake and Saxby Signal Company, of 82, York Road, London. These frames are of the standard pattern used by the makers for operating railway signals and points, and comprise, in essentials, a sheave round which there is wrapped the bight of a wire rope. The sheave is mounted in appropriate bearings, and can be rotated by a hand lever. The rope is led around the necessary fairleads, and is attached to the distant mechanism which it is desired to operate. Originally the installation was so arranged that the various levers were interlocked and could only be operated in a definite sequence; but experience has shown that it is preferable to rely upon the wits of the operator in a case of emergency.

Wear of Axle-box Bearings.—In his interesting paper entitled "Carriage Bogie Design," read at a meeting of the South American Centre of the Institution of Locomotive Engineers, Mr. W. Heaton referred to the relatively short life of axle-box brasses on many foreign railways as compared with the experience in Great Britain, says the "Railway Gazette." He stated that during last year he had the privilege of examining a number of various classes of brasses which had been in use on British rolling-stock for periods ranging up to 11 years. Most of these brasses were still fit for service, and doubtless to those concerned with the difficulties to be overcome by railways such as the Central Argentine, such a figure would appear as a revelation. The hammering action on the white metal caused by earth-ballasted tracks under varying conditions, the poor class of water obtainable, the long distances of inspection centres from their base, and the frequency of the necessity of adjustment and changing, are some of the features with which the railway engineer has to contend and which do not trouble those concerned with rolling-stock maintenance in the old country. On the Central Argentine Railway the axles are condemned when the diameter of the journals reaches a limiting figure with regard to strength. This minimum journal diameter figure is ascertained from the static weight (tare + load) to be supported, and the maximum stress allowable on the steel under this load, which is 10,000 lb. per square inch. The wear of journal collars and journals in Great Britain is so small that a different factor altogether, namely, that of age, is used for condemnation.

Benguella Railway nearing Completion.—According to the "Railway Gazette" it is reported from Africa that the Benguella Railway from Lobito Bay has now reached the Angola-Belgian Congo border, and that arrangements are in hand for the immediate continuation of the railway through the Congo to a junction with the existing Katanga system. In connection with this railway it is interesting to record that a section of the south-western Congo has been transferred to Portugal in exchange for a small area in the north-west of Angola, the latter being required by Belgium in order to avoid a section of their re-located railway from Matadi eastwards passing through Portuguese territory. The Benguella Railway, with its continuation to the Katanga region, will be 1,125 miles in length and will tap a very rich country. Approximately 780 miles of the line will be in Portuguese Angola, and the balance in the Belgian Congo. The railway, which is on the 3 feet 6-inch gauge, is laid with 60-lb. rails, and has had long sections working for some time. Several Garratt locomotives are in service, these hauling 500 tons over 1 in 40 grades. Immediately connection is made with the Katanga system the first transcontinental railway of Africa will be an accomplished fact, and traffic will pass between the west and east coasts and southwards *viâ* N'dola and Bulawayo, and northwards *viâ* Bukama. With its magnificent natural harbour, Lobito Bay has well been termed the "Great Western Gate of Africa," and it would seem probable that there will be very considerable development in the regions served by this railway once connection is effected with the existing systems in the Belgian Congo.

Grease Lubrication for Locomotives.—The success which, judging by Mr. N. A. Shove's remarks in the course of a paper dealing with locomotive practice in Canada and the United States, delivered before a recent meeting of the Institution of Locomotive Engineers in London, attends the employment of grease lubrication for certain parts of locomotives in America would appear to imply that, for American conditions of railway operation, this form of lubrication is superior to the more usual method of using oil, says the "Railway Gazette." The conditions under which the American railways operate their locomotives are widely different from those applying here. The track there is comparatively rough, the loads are generally heavy, the distances run between stations considerable, and, similarly, the distances between locomotive terminal or change points much longer than apply here. In addition, the class of labour employed for locomotive maintenance is usually less skilled, and to meet this position it is necessary to adopt methods of operation which do not require the maximum attention while the locomotive is in service. The employment of grease lubrication for axle-boxes under these conditions would appear to be a better arrangement than the use of oil, particularly when certain other advantages resulting from its use are taken into account. While the amount of wear of the axle-boxes and journals where grease lubrication is employed is somewhat higher than with oil, at the same time it is not necessary to bed the brasses on to the journals, as, provided the work on the boring machine is done with sufficient accuracy, the brasses can be dropped straight on to the journals without further attention.

General Articles.

ELECTRICALLY OPERATED BALANCED DISC VALVES.

NOTABLE HYDRO-ELECTRIC UNITS FOR CHILE.

THERE is no diminution in the rate of world development in water power, and the total installations to-day exceed 35,000,000 h.-p., a gigantic figure, which is however only a fraction of the total available, estimated on a most conservative basis to be 450,000,000 h.-p., quite apart from the tides. Much attention is now being given to the subject in South America, and we are able to reproduce photographs of three very interesting 1·8 metre diameter cast iron, double flanged, balanced, disc valves, electrically operated, which have been constructed by Messrs. Glenfield and Kennedy, Limited, of Kilmarnock, for the Cia Hidro Electria Volcan of Chile, to the order of Messrs. Whitehall Securities Corporation, Limited, of London, in conjunction with Messrs. Pearson and Son, Limited, of London.

Each of these valves when complete will weigh 7 tons, being suitable for a working pressure of 50 lb. per square inch, and the equipment includes 12-inch cast iron, bye-pass valves and bends complete, with the gearing enclosed in cast iron casing. The units are intended for outside work, and accordingly the whole of the electrical equipment is weatherproof, the motors and other gear being shown on the left-hand side of the photograph.

The motors are each 3 b. h. p., totally enclosed as indicated, of the squirrel cage reversing type, operating with A/C 3-phase, 50 cycles, and 380 volts, while they can be controlled both locally and on the distant principle from a central switchboard, and, further, the valves are provided with removal steel crank handles for manual operation.

It is well known that Messrs. Glenfield and Kennedy, Limited, have long specialised on the distant electrical control of valves in general for water, sewage, effluents, oil, and other liquids, as well as low pressure and high pressure steam, and the general electric equipment to-day is both simple and efficient, consisting essentially of either an A/C or D/C motor, two limit switches, a circuit breaker, and a controller. Naturally there are many minor modifications to suit particular conditions, but as a rule the motor is mounted near the valve, as shown in the photograph, and is fitted with totally enclosed, grease filled, ball bearings, requiring no attention for long periods, while the connecting worm gear is equipped with ball thrust washers and coupled to the motor through a solid coupling of cast iron, no clutch device being employed. Further, for distant control the trip gear is fitted in a cast iron hood direct over the valve centre and slotted down the front, which allows of the easy rise and fall of a small crosshead attached to a runner nut, carried by the tail end of the main screw. Also the crosshead has a small roller which engages with either arm of the limit switches at the required distance, thus controlling the valve travel, while there are many refinements of designs, ensuring for example that it is impossible for the valve to become jammed in its seating or to over-run the proper period of its travel.

MODERN RAILWAY OPERATION.

THE above is the title of a volume in Pitman's Transport Library, by David R. Lamb, the Editor of "Modern Transport." It is obviously a work which should be in the possession of every railwayman concerned with railway construction and administration. It was intended primarily as a guide to those studying for the examinations of the Institute of Transport, and was published in 1926.

The first chapter deals with railway organisation, and it is said the modern railway company may be regarded as the most complex of undertakings, being concerned with every branch of commerce, with law, and with all phases of engineering, the staffs embracing every conceivable occupation, in one form or the other. Our author would regard a railway as a manufacturing concern, producing the commodity known as transport! A very instructive chart shows the reorganisation of the extended Southern Railway Companies of Great Britain, and is most certainly a matter for careful study. The reorganisation is of an essentially divisional character, and experience only is now necessary to determine the internal changes desirable to secure complete efficiency, reducing departmental friction and superfluous correspondence, and thereby adding to *esprit de corps*. The divisional system deals with railway work under 4 main heads:—(*a*) Track, (*b*) Rolling stock, (*c*) Securing business, and (*d*) Dealing with it when got. Over all is a General Manager, with a chief officer (subordinate to the G. M.) and controlling each of the above main heads. The rest is a matter of mere convenience and detail. The Southern Railways Reorganisation seems capable of simplification. The Great Indian Peninsula Railway has recently adopted a divisional system, and so far with marked success. The author complains that the personnel of the British Railways have been steadily trained to departmentalism; a working of separated staffs in water-tight departments. The improved system is thereby rendered the more difficult of introduction. [What would the author say to the Government of India and its departmentalisms!]

Chapter II deals with passenger station design and operation. It describes various kinds of stations, and shows how comparatively small changes in design can influence costs and profits. A notable example is the dealing with locomotives, both steam and electric, and in supplying the former with water and fuel, at stops, in the minimum of time. The secret lies in efficient service of supply, and in reducing time wasted in movement and in waiting for a clear line.

Freight terminals hold chapter III. It would appear that many railways might with advantage build new depôts to replace those in use, whatever the cost. Reduced to the elements, a depôt consists of a yard, a shed, and a warehouse. The test of efficiency is of course the rapidity with which goods can be passed through the yard and the shed. And, we might add, the rapidity with which goods in the warehouse which have "outstayed their welcome" can be cleared out, and sold by public auction or otherwise disposed of. The chapter is most comprehensive on points of arrangement and design. The more straightforward and simplest plans are in the long run the best-paying and most satisfactory. Chapter IV deals with management (operation). Naturally, these fall into two distinct "grooves," (1) inside or clerical, and (2) outside or operating. There is the Goods Agent; with his chief clerk as second-in-command; and the chief foreman, controlling all the labour in the yard and its buildings, and obliged to accept orders from and through the chief clerk, to allow the Goods Agent to leave the depôt when necessary. The arrangement does not imply subordination so much as a convenient channel of communication. The chief clerk issues wrong or improper orders at his peril. The accounts are similarly undertaken by an accountant in the yard, similarly under the "orders" of the chief clerk, but really answerable for the accuracy of the accounts to the Head Accountant of the Railway. The method ensures promptness and efficiency, but much of course depends on the tact and good sense of the chief clerk. A time-saving device strongly recommended is the making out of all the copies of any document, which are required, in one and the same operation of typewriting. The saving in time and money, and assured accuracy, are remarkable. The telephone plays an important part in the rapid working of a yard. The chapter is full of interest.

Marshalling Yards occupy chapter V. They are nests of sidings at which wagons can be arranged to minimise shunting at the stations to which they are

consigned. The wagons may be loaded or returning empties. The object is that every locomotive shall haul its maximum load in travelling, at any rate, on departure. Gravitation is useful in saving engine power, and it is said "hump" yards are most economical, safe, and efficient, in which the wagons are propelled over the summit of a hump from whence they finish their journey by gravitation. Apparently a sharp distinction should be made between marshalling and storage yards. The risks to the shunters are fully described; and taking this into consideration and the truly terrible noise caused by shunting operations, it is surprising that no mention is made of traversing rails and machinery to pass wagons from one line of rails sideways to another. To retard wagons in shunting, systems of rail-brakes have been introduced, with excellent results in economy and safety; it is clear that the process of introducing machinery for traversing cars, may have equally valuable results, not the least being far less of noise.

Enough has been said to interest the reader in this book. The remaining chapters deal with the working of traffic principally. It is a singular fact that no remarks are made regarding that egregious "invention:" summer-time. A very useful and sensible observation needs mention: "The mere fact that a particular train rarely runs to time indicates a radical defect which should be eliminated." Engine-power is fully dealt with, and it is complained that branch lines are only too often worked by costly and powerful engines for the greater portion of their steam-time engaged in trifling shuntings and other inadequate duty. The point is, of course, that labour itself is so costly, that it is often cheaper to waste the time of the costly machine than to double the labour, since two men operate an enormous locomotive as easily as a pony-engine, and less than two highly-paid men cannot be carried in either. Our author suggests special rail-coaches, and small one-man operated locomotives; but the labour unions with their obsessions on the subject of Capital, may not see the improvement in the same light. A most fascinating and all-too-brief description is given of the "Garratt," the "Fairlie," and the booster.

Locomotive running is an art in itself, as every railwayman knows. Considerable economies are being effected by the mechanical handling of coal, and by washing out hot boilers with *hot* water.

Rolling stock presents enormous problems. The most unfortunate disadvantage the British Railways suffer under is the fact that some 46 per cent. of all the wagons operated belong to private owners, and that these wagons represent a capital value of about £55 to £60 millions. These private wagons cause more trouble, delays, and expense in running, than they are worth; yet the law is such that it is not possible to get rid of them. The saving by their abolition might easily be from £600,000 to £1 million per annum. The worst feature is that the wagons are used very frequently as travelling warehouses.

Passenger rolling stock is remarkable for the enormous proportion of dead-weight to paying load. The British figure is approximately 16 cwt. per first-class passenger, and 13¾ cwt. per third-class passenger. A typical train weighs 441 tons and carries 242 first-class and 216 second-class passengers; and it may not be fully occupied. The locomotive is, of course, an extra weight. The dead-weight of the train alone works out to 19¼ cwt. per passenger. Articulated train-sets are now being adopted with economy and added comfort. For goods, no doubt, we shall arrive at the articulated moving platform, and 5-ton container, placed and removed by steam or electric crane.

It is impossible in this brief article to say more of this important book, which should be widely studied and read, and by engineers other than railwaymen. The art of organisation concerns all branches of engineering; and most decidedly the British Railways are re-organising to a higher and higher state of efficiency. The principles are of universal application.

Σ. Φ.

FLOOD DISCHARGE OF THE SOHAN RIVER NEAR RAWALPINDI.

(BY H. C. GRANVILLE.)

III.

As your correspondent appears to assume that I gave a graphical solution of how to determine the maximum rate of discharge from the Sohan River catchment area, I again refer him to pages 222, 223 and 265 of INDIAN ENGINEERING of 16th October 1926 and 6th November 1926. I make a few extracts to clarify this matter. On page 222, I gave my approximate estimate of the maximum rate of discharge, based on my past experience of this catchment area, in a tabular statement, and stated "the flood discharge graph of the Sohan river is based on the following data," *i. e.*, on the figures in the tabular statement; and on page 265 of INDIAN ENGINEERING of 6th November 1926, to guard myself against such criticism as your correspondent is pleased to indulge in, I wrote, "We must therefore realise that any errors in these assumptions are imported into the final results." In drawing the hydrograph (assumed) for area 3 (*vide* page 223), I wrote "area 3 produces a maximum rate of discharge = 32 square mile inches per hour .... the rate of discharge at *a* is zero, when the rainfall begins, and *rises uniformly* (another supposition) to its peak rate of discharge = 32 square mile inch per hour at the end of 2¼ hours, etc." It really did not matter what slope I gave to the line *ac* (area 3) or to the line fg so long as the point *c* was vertically over the time period 2¼ hours and the point f over point e. I was only illustrating how, if we had absolutely reliable hydrographs, it would be possible to present to the eye a picture of the rate of contribution from each area to the resultant flood hydrograph at the bridge site, at any moment between zero level and peak level. The flood hydrograph taken at the bridge site would not show a student the synchronism in the discharges of the various tributaries, whereby the peak flood accumulates at the bridge site under consideration. Maximum floods on all streams of the size of the Sohan river are due to a rainstorm that has covered the whole drainage area. Mr. Buyers' article in the journal of the Institution of Engineers (India) of July 1926, showed that a depth of 6 inches to 7 inches of rain fell during 24 hours on an area * of 768 square miles on 19th August 1923 on the Sone catchment area. I allowed for a depth of 6 inches in 6 hours to fall on the Sohan catchment. In the face of all that I wrote to prevent any misunderstanding of my graph, it is, to say the least, disconcerting to read your correspondent's captious criticisms, such as, "the hydrographs are trapezoids and as the rate of run-off in each is constant it follows that the area chained off in square miles is directly proportional to the time. As an example in area (3) 80 square miles begin to discharge in 2¼ hours, or 36 square miles per hour, and one square mile would have a time of $1{\cdot}7 = \frac{60}{36}$ minutes, etc." Your correspondent's arithmetic is quite correct; does he mean that an *area contribution* to the peak discharge at the *rate* of 36 square miles per hour is contrary to all experience? The length of the boundary of area (3) is about 45 to 50 miles along the "divide" of area (3). A width of one mile along this boundary would give 45 to 50 square miles contributing to the peak discharge at its outfall. The slopes of the ground over this mile in width are at a maximum for this area (3) and I know the ground, having been over most part of it. The slopes are nearly vertical at the "ridge" and vary over the mile width, but nowhere are less than about ⅓. This 45 to 50 square miles is probably discharging the rain falling on it at the rate of over 100 square miles

* *Vide* INDIAN ENGINEERING, page 40, of 16th July 1927.

per hour. Take the case of the Panjhra * river; catchment area 788 square miles; flood rose from normal to peak in 10½ hours; rate of contribution at time of peak 75 square miles per hour. Your correspondent's criticism appears in INDIAN ENGINEERING of 30th July 1927, and it is possible he had not read and studied my article in INDIAN ENGINEERING of 16th July 1927. The Panjhra is a Western Ghats catchment, with steep trap rock and uncultivated hills, which, at its head, are 4,500 feet above sea level (I am reading from a map of the West Khandesh Collectorate); the valley is "black soil" cultivated. The area (3) Sohan catchment is 6,500 feet above sea level at its head, is covered with forest and undergrowth, and at its outfall is about 2,500 feet above sea level; a fall of 4,000 feet in 18 miles, and very steep hillsides converging on the valley in which lies the main channel. I have seen this channel in flood, and know how rapidly floods pass down it. The time taken for a flood to rise from normal to peak depends on the intensity of the rainfall and its duration; on the size and shape of the catchment area; on the arrangement of its minor channels and rills; on *the slopes of the ground especially* and on the amount of storage or retention of rainwater. The "time of catchment" area (3) *if lying in a flat alluvial plain*, such as one finds in the Loodhiana and Patiala districts of the Punjab, and having such gradients as the country irrigated by the Sirhind Canal, would probably be 6 hours. †

Mr. Lillie's *size* variation factor $\lambda = \frac{1\cdot1 + \log L}{2\cdot4}$, would in this case be $= 1$, as $L = 18$, *i. e.*, less than 20 miles; and his $\Sigma\ \theta^{0\cdot}L$, or *shape* variation factor, would be the same whether the area (3) is laid out flat in the Punjab plains, or, as in the case of the Sohan river, is in steep, well wooded and protected mountains. In Mr. Lillie's formula there is no factor relating to the general slope of the country, and the slopes in the main channel and its contributories, ‡ because his formula is to be used only to ascertain the potential maximum flood section at the outfall. Mr. Farrant's formula is based on a mean velocity of 3·2 miles per hour, equivalent to 4·7 feet per second, for *all areas* up to 40,000 square miles, because it professes to give the maximum rate of discharge in cusecs. But, though 4·7 feet per second is applicable to the run-off of *some areas* in flat alluvial soil, such as one sees along the Sirhind Canal, we must remember that "the steeper the slope of the country the faster will the water run off and the greater, therefore, will be the maximum rate of discharge." §

The floods in very large rivers in the plains of India usually rise slowly, endure for several days and slowly recede. In small rivers the rise is rapid, the duration short, and the recession rapid, and is measurable in hours. When no surface storage or retention exists on the drainage area, and when the stream has adequate storage capacity, *i. e.*, there is no overflow and consequent valley storage at flood stages, the time of flood advance and flood recession is approximately equal, as shown by flood hydrographs. The presence of storage or retention on a drainage area, therefore, reduces the intensity of the flood peak and prolongs the duration of the flow.

I have before me some flood hydrographs of rivers—from which I calculate as follows:—

Miami River at Dayton, Ohio; drainage area 2,525 square miles; river rose from normal to peak in 33 hours; rate of contribution 76 square miles per hour. Rainfall of nearly 7 inches in 3 days; a larger fall than this would have reduced the time of rise of flood from normal to peak. Country flat.

Scioto River at Columbus, Ohio; drainage area 1,614 square miles; river rose from normal to peak in 27 hours; rate of contribution at time of peak equal to 60 square miles per hour. Rainfall only 5·7 inches in 3 days. Country is of easy gradient!

Wisconsin River, Wisconsin, U. S. A.; drainage area 1,520 square miles; river rose from normal to peak in about 16 hours; rate of contribution 95 square miles per hour. Rainfall 5·15 inches in one day of 24 hours.

As regards the plan of the Sohan I have sent a correction slip. Mr. Lillie says * "the width of the river at the site is 1,000 feet, which is a trifle above the average of the 2 or 3 miles of the river shown on the plan." No longitudinal section, and no cross sections were shown on the plan prepared and published by Colonel Taylor, R. E. There is no gorge and no rapid through it. The criticisms would have been very helpful if supported by facts.

APPENDIX.

In looking through an old Diary—"The Indian and Eastern Engineer" Diary 1896—a few days ago I came across these entries.

The average annual rainfall at Rawalpindi is 31 inches.

Number of days, on the average, per annum, when rainfall is less than 1 inch in 24 hours = 43.

Number of days, on the average, per annum, when rainfall is between 1 to 2 inches in 24 hours = 5.

Number of days, on the average, per annum, when rainfall is 2 inches and more in 24 hours = 5.

Maximum number of days per annum on which rain fell = 72.

Average number of days per annum on which rain fell = 53.

Heaviest rainfall on any single day of 24 hours was 9·5 inches on 20th July 1893; during 1889 to 1896, and excluding the rainfall of 20th July 1893, the heaviest rainfall in a day of 24 hours was 5·82 inches in July 1890. These notes were made after my study of the rainfall records of Rawalpindi town, when preparing the drainage project for the City of Rawalpindi during 1926.

On page 278 of INDIAN ENGINEERING, dated 14th May 1927, I gave the discharge of an extraordinary flood, on the 3rd August 1909, in the Hathmati river whose drainage area is 524 square miles, as 0·467 inch per hour per square mile, and stated in the column of remarks "The rainfall at the weir site was 7 inches in 14 hours and 10 inches deep at the centre of the catchment," and stated that the intensities of rainfall on the Hathmati river catchment are greater than on the Sohan river catchment.

* INDIAN ENGINEERING, page 41, of 16th July 1927.

† $\frac{80}{6} = 13\frac{1}{3}$ square miles per hour.

‡ Read INDIAN ENGINEERING, page 251, of 1st May 1926.

§ Lillie on catchment area discharge in India, Vol. ccxvii, Pro. Inst. C. E., page 300.

* Read page 327 of Vol. ccxvii, Pro. Inst. of C. E.

THE ECONOMIC AND SOCIAL DEVELOPMENT OF THE AMERICAN IRON AND STEEL INDUSTRY.

(Concluded from page 350, December 17, 1927.)

THE United States Steel Corporation commenced business on 1st April 1901 with a capital structure of nearly 1½ billion dollars. It represented a merger of ten large companies, each prominent in its own field. It was a consolidation of consolidations, most daring in its conception and destined to be monumental in its achievement. Its initial capacity in steel ingots and castings was 9½ million tons, which comprised 65 per cent. of the country's total output. To-day it represents but 45 per cent. of the nation's tonnage with its production of 23 million tons.

At the time of its organisation the failure of the enterprise was freely prophesied because of its colossal size. The public was suspicious of its monopolistic potentiality. Organised labour dreaded its power, and rivals feared possible unfair competition. During its existence it has twice been seriously attacked by organised labour, and for years it was in the courts because of the Government suit brought for its dissolution.

In spite of dire prophecy and unjust attack the Corporation, after more than a quarter of a century of constructive effort, not only stands to-day absolved by the Government and the people of unfair practice, but is recognised throughout industry as an exemplar of efficiency and high business standards.

Since the beginning of the United States Steel Corporation Judge E. H. Gary has guided its policies. To him is largely due that publicity in corporate affairs which principally found its birth in the innovation of regular and detailed statements of the Corporation's activities. To the public the Corporation's policy has meant reasonable prices and knowledge of the Corporation's results; to its competitors, co-operation and a stabilising influence; to its employés a more generous return than ever before paid by the industry; and to its stockholders a fair return on their investment.

In management as in other departments of American industry the job seeks the man, and character and ability are the determining factors. Perhaps nowhere is the success of this dominant policy more strikingly illustrated than in the leaders of America's two largest corporations in the steel industry. The character and accomplishment of Elbert H. Gary and James A. Farrell of the United States Steel Corporation, and Charles M. Schwab and Eugene G. Grace of the Bethlehem Steel Company, chief executives and presidents respectively of their corporations, need no elaboration here. Their prestige and resource is distinctly an heritage of ability and hard work, and their history symbolises to a marked degree American opportunity and American accomplishment.

Labour.—Because of the large increase in the number of small investors the line of demarcation between so-called labour and capital is rapidly lessening. There is a better appreciation to-day that the nation's capital is principally the savings of labour's thrift and is largely owned by labour itself. With the dissemination of this truth has also gone a better realisation that in American industry the labour of the office and counting-room is in the same economic category as the labour of the mill or field, and that the officials of management are just as truly employés of the Corporation which hires them as the men working under their direction.

The composite American workman is of a high order of intelligence, peculiarly free from traditional bias and restraint, and welcomes as a rule mechanical assistance for the increasing of his output because of its greater attendant earnings. He is especially jealous of his right to freedom of action, is quick to resent unjust treatment, and does not hesitate to change the character or place of his employment if dissatisfied or if better opportunity presents. He resents political and organised domination, and prefers his own negotiations to bargaining by representatives.

That these statements reasonably reflect the general character of the largely predominating mass of skilled labour in the United States to-day is demonstrated by the fact that attempted political dictation by organised labour even in their own ranks has been a failure, and that the United States is essentially an open-shop country. Of the 117,000,000 of its inhabitants about 8,500,000 are found in the manufacturing industry. Organised labour has in its enrolment something less than 4,000,000 workers, and these are principally found in the mining, transport, building, and textile industries.

Formerly when short-sighted management oft-times led to the oppression of the worker, and when co-operation between employer and employé was more stressed by its breach than by its observance, organisation of labour grew rapidly, because of its protective appeal to the individual. To-day, however, a better understanding of common aims and a clearer knowledge that even armed neutrality is unprofitable, has resulted in an appreciable lessening of interest on the part of the worker in labour organisations, as is indicated by a reduction in the membership of the American Federation of Labour from 4,078,740 in 1920 to 2,803,966 in 1926.

The iron and steel industry of the United States is operated on an open-shop basis. Employment is not concerned with nationality, politics, religion, or union affiliation; and plant representation, negotiation as to wages, and methods of work are distinctly between the management and the men, singly or collectively, and not through outside agents.

An exception to this general rule is found in a few small mills where the Amalgamated Association of Iron and Steel Workers is still recognised. That their influence is small is indicated by the fact that while the iron and steel industry employs about 400,000 men, the Amalgamated Association's enrolment has fallen from a membership of 14,035 in 1900 to 11,174 in 1926.

Some of the American labour unions have maintained their position through conservative leadership and the rejection of radicalism. More, however, have lost ground by attempting militantly to force domination on peaceful industry and by insisting on wages, hours, and rules that were unfair to the public because out of harmony with economic principles and existing conditions.

It is one thing for labour or for management to use its might to right a wrong. It is another thing to disrupt a community or a nation for selfish aggrandisement, and American public opinion has thus far refused to sanction special privilege to either labour, management, or capital.

As a result of this attitude both management and labour have found that fair dealing is remunerative as well as ethical; and that co-operation is more productive than oppression. That there has been of late years much better co-operation on the part of the vast majority of the labour body is by no means solely due to the higher wages that they have received. Management early in the century began more practically to recognise their obligations to the human side of industry. It found that the minimisation of occupational hazard, sanitary surroundings, hospitals, better housing, and other welfare work which promoted the health and happiness of the worker and his family, was not only humane, but paid by the goodwill and the co-operative spirit that it inculcated. In the development and application of this new science of human engineering the iron and steel industry, inspired by the example of the United States Steel Corporation, has taken a most prominent part.

In 1906 the United States Steel Corporation inaugurated a campaign of safety, sanitation, and welfare which has ever since been vigorously pursued. Tonnage and costs became no longer the *sine qua non* of achievement, and the safety and welfare of the worker is a vital consideration in mill operations.

Accident prevention has naturally been most prominently stressed. The safeguarding of machinery starts with the drafting board in all construction, and is diligently pursued thereafter as experience permits. Education and organisation of men into safety committees plays an important part, and that expense is not allowed to interfere with the desired object is indicated by the expenditure by the United States Steel Corporation last year of 1¾ million dollars in safety work.

As a result of such intensified effort extraordinary reduction in the accident rate has been achieved. Among the quarter of a million men employed by the United States Steel Corporation in 1926 the rate of disabling accidents was 3·26 per cent. as compared with 20·57 per cent. in 1912, or a reduction of 84·15 per cent. of the former rate. That means that in the company 365,277 men have been saved from disabling injuries since 1912, as measured by the sum of the reduction in accidents each year.

In addition to the payment of liberal wages, various corporations seek to improve the financial condition of their employés by affording them the privilege of stock subscription on advantageous terms. In the United States Steel Corporation, in illustration, there were 47,647 employés registered as stockholders as on 31st December 1925, who held 665,801 shares of the Corporation's preferred and common stock, with an

aggregate value of over 100 million dollars. Like the Corporation's safety and other welfare activities, this method of encouraging a partnership relation is absolutely divorced from any paternalistic method or condition, to which both men and management rightfully object.

Consumption and Markets.—At the beginning of the century the United States, with a population of 76,000,000 people, produced 9½ million tons of finished steel, while in 1926, with a population of 117,000,000, this output has risen to 35½ million tons. In other words, each inhabitant as an average used 739 lb. of finished steel in 1926 as compared with 279 lb. in 1900, or over 2½ times more now than formerly. This expansion is essentially due to increased domestic demand, and has been but little influenced by the small percentage of growth in the country's foreign trade. The following statistics show how small this change has been. The iron and steel imports and exports of the United States, in round numbers, were respectively 200,000 tons and 1,000,000 tons in 1900 as compared with imports of 1,000,000 tons and exports of 2,000,000 tons in 1926.

The increasing ramifications of steel's new uses are continually making for widening markets. With greater diversification of product has come an insistent demand for quality, so that to-day trade requirements are infinitely more severe than in former years. The comparatively rapid growth of alloy steels and the increasing call for electrical refining is a result of this demand, and such special steels are an important and growing factor in the economic progress of the country. The change in the character of the demand is illustrated by the item of rails. At the beginning of the century the production of rails absorbed 25 per cent. of the country's entire steel output. Last year, although the rail tonnage was half again as large as it was twenty-five years ago, it represented only 9 per cent. of the country's steel production.

In the new demand for steel the most important development is the expansion of the automotive industry, which last year took 15 per cent. of the nation's output.

In the development of this industry the accomplishment of Henry Ford is outstanding. To his genius, courage, and vision we must pay high tribute, when analysing the effect of high production and the increased *per capita* production that has followed his methods. To his doors has come the world to study the specialisation of men and machines, and his practice and high wages have been made prosperity's text by various international expounders of economic and social conditions. But while industry owes much to Mr. Ford, his methods and his results may easily lead to false conclusions if superficially studied. Thanks to his foresight and inventive genius, he produced a car which in its sturdiness and its low price so far outclassed his competitors as to amount temporarily to a monopoly. With an almost insatiable public demand, his profits, though legitimately made, were so large as to put his enterprise outside the pale of ordinary competitive conditions.

It is as a monopoly, not as a competitive industry, that Mr. Ford's past achievement must be studied if proper deductions are to be drawn. The present intensive competition by powerful interests, in low-priced models, promises to emphasise this fact.

Between the manufacturers of steel in the United States there is free exchange of ideas and information in respect to equipment and practice, and former secrecy has given way to a courteous welcome to both foreign and domestic competitors. In the matter of sales, however, while information concerning prices may be legally exchanged, anything in the way of price agreement or restraint of trade is outside the law. Although industrial combination carries with it the possibility of service to the community by saving in operation and saving in distribution, it may also carry with it the possibility of unreasonable prices. That the public in the United States feared the possible monopolistic power of the industrial merger more than it appreciated its constructive force is evidenced by the Sherman anti-trust law and the subsequent anti-trust legislation that has been enacted. The difference between governmental encouragement of the cartel in Europe and the discouragement of industrial combinations in the United States is, therefore, a difference in the public state of mind. That the United States laws against trade agreement and in favonr of unrestricted competition are economically sound is subject to grave question. That uncontrolled licence to combine would be in the long run more economically sound is likewise open to doubt. Possibly a happy medium could be found in permissive regulation. In any event, President Coolidge's dictum of more business in government and less government in business rings true in the light of general experience.

SUMMARY.

The economic progress or retrogression of any nation depends upon the expansion or curtailment of the individual production of its workers, and the secret of America's well-being lies in its unrivalled *per capita* output.

At the back of all accomplishment, however, is human effort, and the installation of power and the wealth of material resource will be but abortive aids unless utilised and directed by the hand of able and willing labour.

The character of any people depends upon their education and environment, and their material welfare can only be assured if founded upon sound economic methods. The irrevocable law of supply and demand is nothing but human nature reduced to a formula, and composite human nature is unchangeable in its primary instincts in spite of civilisation's veneer.

Consumption is vitally affected by costs of production, but for management to lower costs by reducing wages if they are reasonable is just as shortsighted as for labour to try to improve its condition by restricting its output. Both, if continued, must inevitably lead to lower standards of living.

High wages and high dividends can only come from high production, and high production will be better assured if labour is not only paid to produce but also is paid by what they produce. Tonnage rates, piecework, and bonuses for favourable performance spell high earnings when justly formulated, and American production owes much to this enlightened method of labour remuneration.

Prosperity to continue must be based upon a thriving public, contented labour, and adequately remunerated capital. If any one of this essential trinity becomes unbalanced the wheels of industry will slow down and prosperity disappear.

As a prophet may not be without honour, save in his own country, the author ventures the prediction that as war has given way to peace, so will ignorance give way to economic enlightenment, and that in the new spirit of industrial co-operation there will be found both greater prosperity and a better understanding between the nation of the earth.

The Gazettes.

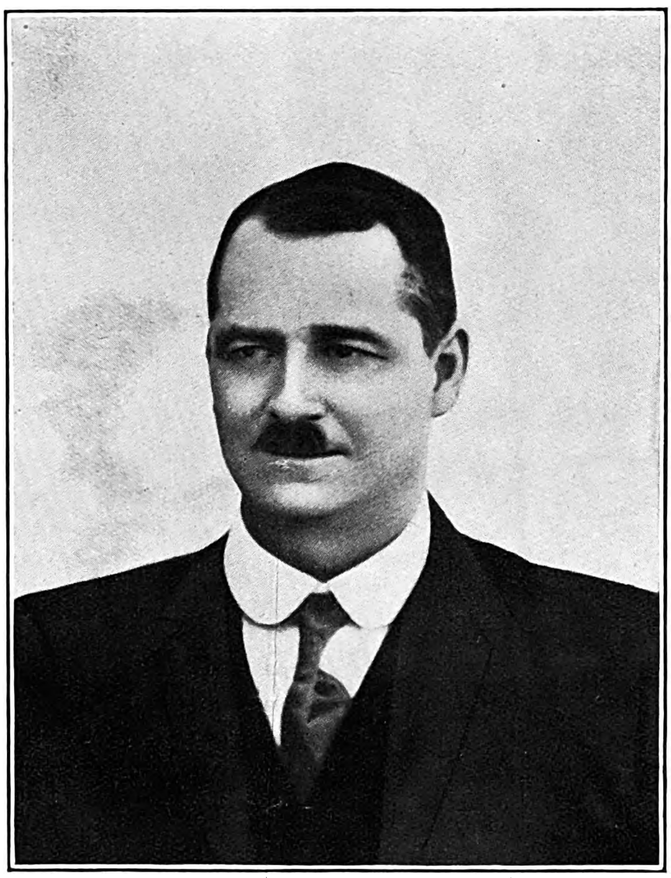
Punjab, December 30, 1927.

Hydro-Electric Branch.

On transfer from the P/p (Pipe line) Subdivision, of the "P" (Power Station) Division, which he left on 15th November 1927, Captain H. A. Kenyon, M. C., R. E., Assistant Executive Engineer, joined the "E" (Engineering) Circle, Lahore, as an attached officer on 18th November 1927.

Irrigation Branch.

Lala Sunder Das, Pahwa, Assistant Engineer, on transfer from the Okara Division, Lower Bari Doab Canal, which he left on 19th November 1927, joined the Khanewal Division, Lower Bari Doab Canal, on the 21st idem. Lala Sunder Das, Pahwa, left Khanewal Division, Lower Bari Doab Canal, on the same date and joined the Okara Division, Lower Bari Doab Canal, on 26th November 1927.



MR. JOSEPH WILLIAM BEACON LOUGHRAN.

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INDIAN ENGINEERING.

SATURDAY, JANUARY 14, 1928.

JOSEPH WILLIAM BEACON LOUGHRAN.

AN APPRECIATION.

SAD as death is, it may not be so said when a man has lived the fulness of his days and life becomes a burden; but there is always something pathetic in the cry, *mori est felicis antequam mortem invocet,* and the news of the death of Mr. Loughran of the Panjab Irrigation came to brother-engineers who knew him intimately, professionally and personally, with a poignant sense of shock.

To tell the story of it—Mr. Loughran would seem to have been born under an unlucky star. With a real and natural love for engineering, he entered the Thomason College, Roorkhee, and was in due course appointed to the Public Works Department as one of the first of the Provincial Engineers on the two-thirds salary basis. The new system was ostensibly the outcome of the recommendations of the Public Service Commission of 1888, and it seems to have been held from what the Commission said that there was scope in the Department for an inferior branch of the service for the purposes of certain classes of work for which high qualifications were not essential. But the Provincial Engineers were employed on duties similar in every way to those of others appointed under more favourable conditions, and it is not surprising that they should have bitterly resented working shoulder to shoulder with men on pay so superior to their own. The change of system showed a want of knowledge of human nature, and it subsequently led to trouble. Mr. Loughran must have felt the position in which he was placed, as did the rest, and possibly more acutely as he was very sensitive by temperament; but whatever his feelings may have been, he did not permit them to affect his work. From the first, he was an excellent Assistant Engineer, the sort of Assistant that superior officers like to have, which is one of the best of criterions of a man's merits, and when in 1905 he was given divisional charge on the construction of the Upper Jhelum Canal he came still more prominently to the front. The Upper Jhelum from the point of view of engineering was the most difficult of the Triple Canals, and in a sense it is the most important link of the series. Designed to carry the surplus waters of the Jhelum river to the Chenab, and so to set free a portion of the Chenab river supplies for the irrigation of the large and arid tract of country on the far side of the Ravi river, known as the Lower Bari Doab, any failure in it implied the failure of the project as a whole, and its integrity was a matter of paramount importance. In the early days of the Upper Jhelum, Mr. Loughran was Mr. Farrant's right-hand man, and did the heavy spade work of the estimates for the earthwork in broken country, involving embankments, some of them 40 feet high, and of other estimates in the thorough manner

which was characteristic of him; and when in 1907 active construction was commenced, and Mr. Farrant had been relieved by Mr. R. Egerton Purves, he proved himself to be a very competent construction engineer. He was not only a first-rate engineer of sound judgment and great mathematical precision and clearness of thought, he was skilled in organisation of labour and work arrangements and in accounts, and was completely in touch with everything that went on in his division. He studied the intensity of rainfall and some of his observations are recorded in Buckley's pocket-book. He was also an accomplished penman, as evidenced by the paper he contributed to the Engineering Congress of 1913 on the vexed question of the cross drainages of the Upper Jhelum Canal. The subject was not a little complicated, and Mr. Loughran dealt with it with technical lucidity and in a literary style not very usual with engineers.

Mr. Loughran's time on the Upper Jhelum Canal from 1905 to 1913 was a very good test of a young engineer's abilities. He had over him a capable and experienced construction engineer in Mr. Egerton Purves' and in addition there was Sir John Benton, with his eyes everywhere, keenly intent on the best of work and rapid progress on what was the most difficult portion of the project of his own making. Mr. Purves is known to have had a high opinion of Mr. Loughran's energy and professional efficiency, in fact he valued his services so highly that when he was promoted to the rank of Chief Engineer and Secretary to Government he brought Mr. Loughran into his office as Under Secretary as soon as a vacancy occurred, and that tells its own tale. Mr. Loughran joined the Secretariat in 1913, and he was presumably as capable an Under Secretary as he had been a practical engineer in the field, for he not only succeeded in maintaining the good opinion Mr. Purves had formed of him but in earning that of Mr. Purves' successors, among whom was Mr. F. W. Woods, the Chief Engineer of the years 1917 to 1921. Mr. Woods was a very good though critical judge of his staff, and he considered Mr. Loughran to be the best engineer of his standing on the irrigation establishment of the Panjab of that time. With that record behind him, Mr. Loughran was bound to be promoted to the Superintending Engineer class when his turn came, and after holding the charge of the important Lower Chenab Canal for a period, he was posted to the Ferozepore circle of the Sutlej Valley project in 1922. Then something happened; an engineer with the qualifications he possessed should have been very valuable on the establishment of the most costly construction work the Panjab had ever undertaken, but he was transferred from the Sutlej Valley to a running-canal circle, and was subsequently superseded, it is believed, on three occasions for promotion to Chief Engineer, which, after the reputation he had earned, must have come as a stunning blow.

Without a knowledge of the facts, the reason for the supersession can only be surmised. Professionally, he had been regarded as on a high standard of merit, and, even assuming that he may have been thought temperamentally or in other ways unsuited for the position of a Chief Engineer and Secretary to Government, explanation is not altogether easy. Mr. Loughran was not the hail-fellow-well-met stamp of man who likes company and laughter, the rubbing of shoulders with a crowd, the things that make for popularity. He lived solely for his work, but so for the matter of that did Sir John Benton. He avoided socialities, and so did Mr. R. G. Kennedy, whose name is so greatly respected in the Panjab that the Kennedy Medal was founded in his honour. He was shy and self-tormenting, as sensitive as a compass needle to blame and rough speech, but that did not mean that he was wanting in courage. He was fearless in the independence of his views, and he had shown that he could face toil and difficulties undismayed. We are built in many different moulds, and it is not always the man of bluff, congenial disposition who achieves most. As Emerson said in one of his essays: "If Newton and Archimedes had been good fellows, fond of dancing, port and clubs, we should have had no 'Theory of the Sphere,' no 'Principia.'" But, however all that may have been, Mr Loughran felt what he considered was an injustice with great intensity. We are all children when it comes to that form of grievance, we may accept courageously all the other shapes that the slings and arrows of outrageous fortune take, but injustice rankles. It saps the spirit of a sensitive man by its depressing influence, and automatically multiplies itself by dwelling on it. But Mr. Loughran is now dead, he might almost be said to have died of a broken heart, and though the engineers who knew him best will sympathise deeply with the distress he suffered, it is now too late to make him any reparation for it.

ENGINEERING ASSOCIATION OF MALAYA.

THE Transactions for the years 1925 and 1926 show that this Association, though but an infant in age, promises to have robust growth. It was in 1919 when some half a dozen engineers were gathered together in Kuala Lumpur that the idea of forming an Association arose. It was then and there decided to formulate the Articles, and in 1920 the Articles were completed and approval was given by Government to the proposals. In 1921 the Association became an established fact, and the first meeting, with Mr. P. A. Anthony, C. M. G., M. Inst. C. E., as President, was held in February of that year. The membership now numbers 186. Lieutenant-Colonel J. P. Swettenham was the President for 1925 and delivered a very interesting address. He was one of the little group of men who laid, so to speak, the foundations of the Association at Kuala Lumpur in 1919, and it must have been very gratifying to him to have seen the success that has attended those early efforts. Mr. James Craig was the President for 1926, the sixth in turn from the first President of 1921.

Among the papers contributed to the Transactions is one on "The Perting Dam, Ulu Pahang." Half a century or so ago Rajah Impeh brought the first Chinese miners from Selangor through the jungle over the Main Range to exploit the tin deposits of the Perting River. At that time the work was in the hands of the local Malays, and their only implement was a wooden dish, with which the gravel of the stream was treated. The ore obtained was smelted locally, and cast into currency or disposed of elsewhere. The Chinese introduced open cast mining and the water-driven chain-pump, but were not very successful. The pioneer efforts, however, continued and were eventually replaced by more scientific mining. The industry has led to a town of about 4,000 inhabitants, and the paper describes the various operations and the construction of a gravity dam in not too easy a locality. Another paper by Messrs. Gordon M. Peacock and Charles I. Robinson deals with the Perting Hydro-Electric Installation, an installation probably unique in respect of the amount of sand carried by the river at the head-works, the matter in suspension varying from about 2,000 to 8,000 grains per gallon according to the season. A third paper by Messrs. F. G. Coales, A. M. I. C. E., M. I. Struct. E., and C. D. C. Braine, B. Sc., A. M. I. Struct. E., on "Stresses in Two-Hinged Arches" will be welcomed by engineers interested in the construction of reinforced concrete bridges. Bridges of that type may be said to be æsthetically one of the most graceful of all engineering feats, and are specially suitable for large spans. Arches of the type in question, the authors explain, may be divided into three classes, three-hinged, two-hinged and no-hinged. The first presents no difficulty, as a three-hinged arch is statically a determinate structure, the hinge at the centre giving a point of zero bending moment from which the unknown horizontal thrust can be calculated by solving a simple equation. The two-hinged and no-hinged arches are, however, statically indeterminate and require the condition equations for their solution. The three-hinged arch, though more simple as a structure to design, has the disadvantage that it lacks rigidity, and the authors in their paper deal with the method of computing the stresses pertaining to a two-hinged arch without difficulty and with only a very small error. They say that the method they suggest for calculating the horizontal thrust in two-hinged arches is, as far as they are aware, new, and it should prove of practical value to engineers who have this type of arch to design. The paper is an able one, and should be of much utility.

Malaya is a country which from its natural conditions makes many a strong demand on the skill of engineers who have to fight the battle with Nature in it. The rainfall is heavy, about 100 inches. There is some easy country, but much of it is hilly, even mountainous, and there are dense jungles and noisome swamps. In addition too to the natural difficulties engineers have to contend with, they have often to work in places dangerous to health and where there are no amenities of social life. It says much for the Public Works Department of the country that its officers have done such excellent work in many different branches of engineering, with courage and good cheer, and all of us in the profession will wish the Engineering Association the best of good wishes for its future. An Association is wanted in Malaya, it is wanted to promote an *esprit de corps* among the engineers, to enable them to feel that they are not isolated units, working alone, but members of a body, and so by co-operation and by the papers they contribute to be of help to one another. Colonel Swettenham and the other members of the little band, who saw the need of such an institution and who now have the pleasure of seeing the advance that has been made, merit congratulations.

DECORATIVE MOTIVES OF ORIENTAL ART.

THE preface of a new book with the above title by Katherine M. Ball (London: John Lane the Bodley Head, Ltd.) opens with the sentence: "This volume is intended to meet a need greatly felt for an interpretation of the motives that so delightfully enrich the artistry of the Orient." And indeed there is such a need. We all know that if we possess a picture, possibly a beautiful picture, which represents some stirring scene in history, romance or fable, and we do not know the story of it, how piqued we are to learn. We feel that our possession would be all the more valuable, certainly more interesting, to us if we only knew more about it. And that is only a very simple case, for if we happen to be students or amateurs of Eastern architecture or archæology, ceramic art or the many other forms of art in the East, we know that the decorative motives are almost countless and that we should enjoy our studies and our visits, and the collections in museums or possessed by ourselves in far greater degree if we were able to understand them. There is no lack of symbolism in the mediæval art of the West, but in the East there is a positive riot of it, and whether in features of design or of decoration everything seems to have a special significance, known in their entirety only by the cultured people of the country concerned. It may be symbolism which is religious or mystical, it may be historical or legendary, superstitious or merely devices to invoke good fortune, but the forms are legion in number. There are deities and fabled heroes, beasts, birds, fishes, reptiles and even insects, trees, plants, flowers, clouds and manifestation of wind, as well as conventional geometrical patterns, portrayed with definite meaning and not by the caprice of the individual artist. The authoress says: "In

the Orient, art has always been regarded as an important means to an end rather than an end itself. It was used as a medium through which were taught essential lessons of the philosophies of life, in which function it became the auxiliary of ethics and religion."

The book treats of the symbols pertaining to the particular culture that sprang from China and spread through adjacent countries and thence through Korea and Japan more especially, and this can be understood. The art of China has been a vogue in the Occident for a very long time past, possibly because the beauty of Chinese ceramics is unrivalled in the world, there has been much literature on the subject, and much information has been derived from the books, paintings and inscriptions of both China and Japan, translated and interpreted by erudite students of the subject. No one has taken the same trouble with the art of India, as Indian art has never caught on in the West in the same way. A time is coming, we are convinced, when it will be appreciated and receive the attention it deserves, though it has been long delayed. Mr. E. B. Havell, it is true, has written a good deal about it in his works, such as that on "The Ancient and Mediæval Architecture of India: a Study of Indo-Aryan Civilisation." But Mr. Havell, an old Principal of the Calcutta School of Art, an acknowledged expert in all matters concerning Indian art, and genuinely in earnest in his interpretations of symbolism, was apt to interpret over much, which was a pity, as with his enthusiasm and his knowledge he might have taught us so much more.

Miss Ball does not, however, neglect Hindu art by any means. There is the association of the tortoise and the serpent that comes from the Buddhists, and further back than that from the old cult of sun worship. There is a tortoise incarnation of Vishnu, in which form the Preserver descended to the bottom of the sea, and the tortoise from its alleged longevity figures largely in Oriental art. So also does the serpent. Vasuki, together with Sesha and Takshaka, form the triad reigning over the nether regions. Vasuki has many shrines, and the great Sesha-naga is much in evidence in Indian art. Matsya, the fish incarnation of Vishnu, appears in many Hindu sculptures. The elephant is very common, and of course among the ancient deities there is Ganesha, the elder son of Siva, the Destroyer, and of his wife Parvati, with an elephant-head, denoting wisdom and opulence, accompanied by his vehicle, the rat, the emblem of prudence and foresight. There is the bull in sculpture, Nandi, the *vahan* of Siva, with its qualities of the eternal reproductive power of nature. Kartikeya, the god of war, is usually shown mounted on the peacock, Paravani, and also associated with the peacock are Lakhsmi and Sarasvati. And so with many other items of creation which play their various parts in the scheme of Hindu mythology, and a curious thing is that so many of the same creatures should figure in the whole area of the Orient, not always in exactly the same way but with many similar legendary attributes. The authoress has certainly not omitted India in her studies of the many motives of decorative art, nor in her efforts to interpret the symbols, and the volume contains six hundred and seventy-three very good illustrations of the text.

A GREAT MATHEMATICIAN.

MR. SRINIVASA RAMANUJAN of the Madras Presidency died about seven years ago, but his name as one of the most marvellous of mathematicians has come to the front again owing to a new publication, "Collected Papers of Srinivasa Ramanujan," edited by G. H. Hardy, P. V. Seshu Aiyar and B. M. Wilson (Cambridge University Press, 30*s.* net), a volume which also contains a little account of his life. He was born in 1887, and as a school-boy showed that he possessed wonderful mathematical powers. It is said that at school he discovered for himself Euler's expansions for the sine and cosine, and that in his note-books he recorded results he had arrived at, without apparent proof. The fact was what to other people, even great mathematicians, meant proof by laborious calculation, he reached almost by intuition. He had only to turn his thoughts to numbers, and they yielded up their secrets to him, feeling, as it were, that by no possibility could they withhold them. At the age of sixteen Mr. Ramanujan matriculated at the Madras University, but failed to take a degree, no doubt because his mind dwelt on mathematics to the exclusion of other subjects, and it is pathetic to think that a man of his genius should have entered the Madras Port Trust office as a clerk. But genius has a way of proclaiming itself, it did so in Mr. Ramanujan's case, and Mr. E. H. Neville, a Cambridge Fellow, eventually persuaded him to go to England, the University of Madras granting him a scholarship. At Cambridge, Mr. Hardy wrote of him in 1915: "Of his extraordinary gifts there can be no question; in some ways he is the most remarkable mathematician I have ever known." In 1918, he was elected Fellow of Trinity College, Cambridge, and also a Fellow of the Royal Society. He returned to India in 1919 and died in 1920 at the early age of thirty-three. But by that time he had made a great name for himself, and the papers which have now been collected and published cannot fail to be of interest to mathematicians in this country.

Indian Engineering.

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Notes and Comments.

Air Speed Record.—The International Aeronautic Federation has cabled to the Royal Aero Club officially crediting Flight-Lieutenant Webster, the winner of this year's Schneider Cup race, with the world's speed record for seaplanes, his actual speed being declared as 456,232 kilometres an hour.

Canadian Pacific Railway.—One of the four twenty thousand-ton passenger liners being built on the Clyde for this railway is to be launched on the 24th instant from the yards of Messrs. John Brown and Company. Mrs. Baldwin, wife of the Premier, will christen the vessel the "Duchess of Bedford."

Singapore Floating Dock.—This new dock constructed by Messrs. Swan, Hunter and Wigham Richardson, Wallsend-on-Tyne, weighs 50,000 tons and contains 20,000 tons of steel, and 3,500,000 rivets have been used inside. It is to be towed 8,500 miles to Singapore, through the Suez Canal.

Opening of Ghognar Bridge.—This bridge in the Rewa State, a mile and a half from Rewa, was formally opened by His Excellency the Viceroy on the 9th instant. Her Excellency, who accompanied His Excellency, visited Her Highness the Maharani of Rewa at Govindgarh, and then made an excursion on the Lake with His Highness the Maharaja and the rest of the party. A State banquet was held at night.

Hooghly Technical School.—The scheme prepared by the Inspector of Industrial Schools, Bengal, in connection with the proposed Technical School in the district of Hooghly, has been approved by the General Committee formed at a public meeting. The revised initial cost will be about Rs. 32,000. An appeal has been made by the District Magistrate for raising Rs. 10,000. The Government of Bengal will contribute Rs. 16,000.

The Airship R-100.—This Air Ministry's airship which is building at Howden, Yorkshire, is expected to be completed by April next, when after undergoing home trials she will make a demonstation flight across the Atlantic. The passage will occupy 48 hours. This airship which will be the largest in the world is 709 feet long and is to be driven by engines developing 4,200 h.-p. She will have accommodation for 100 passengers and a crew of 50.

The B. B. and C. I. Railway.—The electrified section of this Railway was opened on the 5th instant by His Excellency the Governor of Bombay. The G. I. P. Railway, electrified nearly three years ago, completes a large part of an important scheme of suburban development undertaken to relieve congestion in the city of Bombay and to provide a channel for the flow northward of the increasing residential population. The scheme so far completed has cost over Rs. 2 crores.

Sierra Leone Platinum.—The Colonial Office has announced the discovery of this metal in Sierra Leone. It was found in 1926 by the Director of the Geological Survey, and further recent investigation by him indicates that the platinum bearing area is about 40 square miles in extent, and that the deposits, which are alluvial, are likely to be of considerable importance. An analysis made by the Imperial Institute shows that it compares favourably with platinum from the Urals and South Africa.

Concrete Ships.—That concrete ships have not proven unsuccessful is evidenced by three examples built during the World War period. American Government engineers report that the concrete hull of the S. S. "Atlantus" is in good shape with no sign of spalling or corrosion of reinforcement. The "Peralta" in reported also to be in good condition. The "Palo Alto" constructed on the Pacific coast in 1919 during a recent inspection showed no evidence of disintegration.

Bandra Electrification Scheme.—This is to be completed next month. Messrs. Killick Nixon and Co., Bombay, were granted a license by the Government in 1926 for the supply of electrical energy in the suburban area. It was stipulated that the company should, within two years, complete their works so as to cover the area of their supply. This has been done. By the end of this month the wiring and installation of lights will be completed. After the completion of the electric scheme for Bandra, it wlll be extended to the remaining parts of the suburban area.

News from the African Mines.—Owing to the satisfactory results that have been obtained with the "F. E." Patent Vertical Gravity Dryers, orders have been placed for further equipment through the sole licensees, Fuel Engineering Limited, Parliament Mansions, Victoria Street, Westminster, England. It is to be added that these dryers are now largely used for drying and pre-heating coal; and successful results have been obtained in the drying of ores for milling, thereby increasing the milling output. Other uses for which they are deserving of attention, and are being considered for several projects, include drying of chalk, bauxite, etc.

Light Aeroplanes for Calcutta.—Two light aeroplanes have been ordered from home by Mr. Leete, with whom Captain H. W. Vetch is associated. One of the machines is an Avro Avian fitted with a 32-80 h.-p. engine, similar to the type used in the Moth machine. The second machine is a Westland Widgeon, a light monoplane. The cruising speed of these machines is about 80 miles an hour. Each of these 'planes will be certified for air-worthiness by the British Air Ministry. Upon arrival in Calcutta they will be assembled at the Dum Dum aerodrome. These two machines will arrive in Calcutta towards the end of next month.

Kenya and Uganda Railway.—This railway will provide a direct outlet to the coast and its Tororo-Mbulamuti-Jinga extension was opened on the 11th instant. The new line has been constructed at a cost of £3,500,000. It runs from Mbulamuti to Namasagali on Lake Kioga, through one of the main cotton producing areas to Tororo near the Kenya border, replacing the steamer route. The line then passes across the North Kavirondo district of Kenya and joining the Uasin Gishu Railway, connects with the old main line at Nakuru. Mbulamuti is on the bank of the Victoria Nile and 106 miles from the Kenya-Uganda border.

Barsi Light Railway Co.—The construction of the Miraj-Pandharpur Line by this Railway Company has made the trip to Pandharpur from Southern Mahratta country very convenient and less expensive. The passengers, especially the pilgrims going to Pandharpur for the Ashadi or Kartiki fairs, had to go *viâ* Pooria and undergo a lot of trouble and almost double the expense. The distance between Miraj and Pandharpur is 85 miles, equal to that between Miraj and Belgaum. The

actual construction of the line started on the 1st June 1925, and was completed in September 1927. Due to heavy rain on the line regular traffic commenced from the 3rd November 1927. This Miraj-Pandharpur extension is intended to open up a district at present badly supplied with roads for conveyance of the surplus products of the land.

Lloyd's Shipbuilding Register.—The returns for the quarter ended 31st December 1927, show a world-wide improvement in shipbuilding, the world figures for vessels building being 3,118,721 tons. The figures for Britain and Ireland are double those for the quarter ended December 1926, namely, 1,579,715 tons, now building, of which over 200,000 tons will be registered in the Dominions. Germany is building 472,295 tons and Italy, Holland, France and Sweden over 100,000 tons each, but in no country is the tonnage commenced during the quarter sufficient to replace the tonnage launched. Tanker construction, in which there is a remarkable increase, represents nearly 24 per cent. of the total world tonnage under construction. Shipowners are favouring more and more motor ships, which represent 41 per cent. of the total building in Britain and Ireland, and over 62 per cent. of the total building abroad.

Air Survey Co., Ltd.—The first of the machines which this company intend to use for the survey in the Malda district of Bengal and the Orissa coast, arrived at the Dum Dum aerodrome on the afternoon of the 9th instant, with Mr. Trower as pilot and Mr. Bishop as mechanic. Mr. Trower shortly leaves for Cuttack to begin work at once. A temporary base has already been established from which flights will be made over the coast of Orissa. This survey covers 164 miles of the Orissa coast line with extensions inland at the mouths of the Dhemra and Devi rivers and at False Point. The photographs and maps which will be made will afford considerable assistance to the Expert Committee in their tackling of the problem of floods in the coastal plains. The company will shortly be sending a second machine to begin the Malda Survey, the total area of which to be surveyed is some 1,600 miles.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 29th December 1927 :—Messrs. Sulzer Bros., Calcutta—2 Pumping Sets: Pump, Limax, low lift, centrifugal, sewage type, 12-inch diameter, single stage capacity 100,000 gallons of water per hour against a total head of about 45 feet, driven by 37 b. h. p. protected type, 500 volts, 1,200 r. p. m., motor, complete with control panels and spares, Rs. 7,890 free delivery at railway station, Delhi, by 3rd May 1928; Messrs. Stewarts and Lloyds, Ltd., Calcutta—25,000 running feet Pipes, G.-I., water quality, 1-inch diameter, Rs. 6,446 free delivery at Barakhamba by 17th March 1928; 25,000 running feet Pipes, G.-I., water quality, 1½-inch diameter, Rs. 11,328 free delivery at Barakhamba by 17th March 1928; 25,000 running feet Pipes, G.-I., water quality, 2-inch diameter, Rs. 15,234 free delivery at Barakhamba by 17th March 1928.

Science Congress.—One of the most interesting conclusions included in the programme of the Indian Science Congress in Calcutta was the trip to Bolpur (Dr. Tagore's Biswabharati-International University). They proceeded first to Sriniketan (the centre of local village reconstruction) where the delegates were shown the experimental sericultural station, poultry farm, weaving sheds, etc. The delegates then passed on to the main Santiniketan Asram. Dr. Tagore talked individually to many of his guests and also kindly autographed many photographs of himself which had been previously purchased at the Library. Singhabhaban was next visited. Many of the delegates who were unable to go to Bolpur, took part in excursions that had been arranged for them in Calcutta, to the Broadcasting Station, the Carmichael Medical College and the Bengal Technical Institute at Jadavpur, where they were entertained and shown round by the respective authorities.

Guy Six-Wheeled Trolley 'Buses.—The first six-wheeled electric double-deck trolley 'bus in the world was a Guy with the Rees-Stevens Electric System, and this was put on trial service by Wolverhampton Corporation some 12 months ago. After several months of consistently good service Wolverhampton Corporation placed an order with the makers for 10 of these vehicles for running on the Sedgley and Pennfields routes, where the tramcars have stopped running and the rails have been taken up. Other Wolverhampton tracks on the Tettenhall and Willenhall routes have now gone, allowing for good roads to be formed, and to serve these routes a further order for seven Guy six-wheeled trolley 'buses has been received. The chassis follows the standard Guy practice of six-wheel construction, with the swivelling rear wheels and large pneumatic tyres. The Rees-Stevens Electrical System is also a Wolverhampton product, being supplied by Rees Roturbo Manufacturing Co. The motor will run up to 2,000 r. p. m. and is rated at 60 b. h. p. at 900 r. p. m.

Beam Radio.—Wonders are surging upon us in these days in such a marvellous way that we cannot fully appreciate what is really happening. Round the world in one-seventh of a second, such is the marvellous speed at which radio messages in Morse can be transmitted from the new Marconi Beam wireless station at Dorchester. The possibilities of the Beam system of wireless radio are not yet fully exploited and we have no idea of how they will yet further be exploited. The discoveries now being made are simply amazing and it is difficult to understand how we really stand. Science is making such rapid progress, that we shall have to entirely change our old-fashioned ideas for new ones, which would have been considered nothing short of witchcraft a few years ago. Yet with all our present knowledge, we feel that there is far more beyond our ken which we have not yet attained to. The little we know, is nothing to what yet remains to be revealed to us as the years roll on. Wonders have yet to be unfolded which we little dream of in our present day.

Testing a Thornycroft Six-Wheeler in Australia.—With the object of ascertaining whether a Thornycroft rigid six-wheeler would be capable of taking loads of petrol in bulk through rough country during the winter months, the British Imperial Oil Company of Australia recently submitted a Thornycroft type "A3" rigid six-wheeler to a gruelling test. With a load of 600 gallons this vehicle easily negotiated a lengthy course on one of the worst roads in Victoria over tree trunks, through trenches of mud, and up and down banks of various gradients. Two private cars which accompanied the vehicle on the test became bogged with mud, higher than their radiators and differentials, but the Thornycroft backed into this and

easily pulled each of the cars out. The engineering staff of the British Imperial Oil Company were more than satisfied with the results of the test, out of which the Thornycroft came with flying colours. In view of this amazing performance it is small wonder that this vehicle has been christened locally as the "Mud's Master" and acclaimed as a "lorry which nothing can stop."

East Indian Railway.—Mr. G. L. Colvin, Agent, presiding at a meeting of the Calcutta Advisory Committee, drew attention to the increase in coal earnings which, he said, was due to heavier despatches to up-country. The Committee were shown a statement of the claims statistics, which showed a marked decrease in the claims paid, and the Chairman expressed the hope that the total sum paid in this respect during the present financial year would be under Rs. 3 lakhs. Mr. Colvin attributed the great improvement largely to the working of the Watch and Ward Department and to the use of the Ellis patent lock on wagons which made it difficult for thieves to rob them. Arising out of a debate in the Council of State, last session, a long discussion took place on the necessity or otherwise for changing the procedure of the meeting of the Advisory Committee. Mr. Burman, the Corporation representative, considered that the present composition of the Committee did not adequately represent the interests of the various communities, trades and the travelling public. The majority of the members, however, disagreed with this view and felt that it would be impossible to add to the numbers, without making the Committee unwieldy. They were also of the opinion that the existing rules of procedure for the conduct of the meetings were satisfactory.

Communications in Assam.—His Excellency the Governor discussed many important matters at Tezpur with the members of the Municipal and Local Board on Saturday last. The chief question discussed was an extension eastwards of the Rangia Tangla section of the E. B. Railway. As regards guarantee to the railway of the interest on capital expenditure, Sir Laurie Hammond said that the Government would probably wish to consult the Legislative Council before pledging provincial revenues. If the E. B. Railway were not given the guarantee sought they would probably be unable, at any rate for some time, to undertake the extension. Meanwhile the needs of the districts along the bank of the Brahmaputra for railway services were pressing. The result might be other narrow gauge railways running in connection with steamer services which might block further developments in future. The question of road development was also discussed. His Excellency said the problem was extremely difficult in the Province of Assam. At present there were about 9,500 miles of roads of various descriptions of which only some 450 are metalled, most of these being in the hills. The latest estimate at present shows that excluding the hills, there are at least 1,000 miles of main roads, feeder roads to stations and ghâts and through populous centres which require metalling. The latter costs roughly Rs. 20,000 a mile in initial cost and Rs. 2,000 a year on maintenance. The Government at present contemplated taking a loan of Rs. 75 lakhs which would represent only a third of the total initial expenditure required to place the system of communications in Assam in proper order.

A Handbook on Architecture.—Engineers in the Buildings and Roads branch of the Public Works Department, who have to build and yet feel themselves wanting in knowledge of the art of building, have sometimes felt themselves in need of an inexpensive work on architecture. A recent publication (Architecture. By A. L. N. Russell, A. R. I. B. A., The Simple Guide Series. London: Chatto and Windus, 1927. *7s. 6d.*) may supply that want. It is not easy for an author to take any comprehensive survey of the history and practice of architecture in one small volume, the subject in all its ramifications from the structures of Egypt to modern times is very vast. But Mr. Russell, if he has to take his task at a bit of a gallop, has acquitted himself very well, and the book will teach the beginner a good deal. He commences from early times, and taking the reader through the work of ancient Egypt, Greece and Rome to the Middle Ages and to the great Renaissance, he gives the student a very good idea of the phases of architecture in the past, and still leaves himself a reasonable amount of space to treat of the architecture of modern times. He writes moreover in a crisp and attractive way which makes his book a pleasure to read. Sometimes he may say things with which professional architects may not feel themselves altogether able to agree, but that does not matter, in all professions there is a considerable clash of opinions. The student can disregard that, in the position of a student he has much, ever so much, to learn before he can proclaim his own views, and in that stage of his knowledge he will find Mr. Russell an excellent guide to give him a start.

The Transport of Goods.—Electric industrial trucks have, in the last few years, made great strides in popular favour, and now may be said to have established themselves as indispensable units in the efficient running of the transport about factories, warehouses, railway stations, goods depôts, docks, and so on. In the early days of their existence they had to contend with a considerable amount of prejudice and actual hostility. Labour-saving devices were looked upon askance, and often these handy little machines were deliberately tampered with so that they should not give of their best but be discarded. To-day, however, it is more generally realised that efficiency is essential in the conduct of every business, and that the use of labour-saving devices does not mean more unemployment. Not only are these modern electric trucks time and labour saving appliances, however, but they form an economical means of solving the vexed question of congestion, as five to ten times the weight can be handled with one truck as compared to old hand methods, thus saving confusion and expense. The "Greenbat" Electric Trucks are entirely British, being made by the well-known Yorkshire engineers, Greenwood and Batley, Ltd., of Leeds, and are giving satisfactory service in many parts of the world, railway companies are large users of the type, which are to be found working on the London and North-Eastern Railway, London Midland and Scottish Railway, the Great Western, and the Southern. Overseas, again, they are in use by the railways in South America, India and Japan. One company alone employs over 60. Special care has been taken to make the "Greenbat" Truck fool-proof. The foot pedal must be depressed to close the electrical circuit, the same action releasing the brakes. The pedal is interlocked with the controller, and the latter must be brought to the neutral position before the truck can be started. It is impossible, therefore, to start the truck accidentally by depressing the foot pedal even if the controller is left in the running position. Further, the controller handle is detachable and the truck cannot be operated when it is removed.

The Advantages of the Electric Trolley 'Bus.—The electric trolley 'bus possesses many advantages over other types of passenger vehicle, including both the petrol omnibus and the tramcar. As regards the first, owing to the absence of reciprocating parts and the general simplicity of the mechanism of the trolley 'bus, the cost of maintenance is much lower, while the actual running costs are also considerably less, due to the fact that electricity is the cheapest form of motive power available. In this connection it may be pointed out that as the use of electricity increases so does the cost to the consumer tend to become lower. On the other hand, the cost of petrol is not stable, and is liable to rise as the demand increases. The life of the tyres of a trolley 'bus has also been proved to be appreciably longer than that of the tyres of a petrol 'bus working under similar conditions. Another important feature of the trolley 'bus is the high rate of acceleration which enables the vehicle to attain its maximum running speed in a very short time. As compared with the tramcar, the great saving in expense comes, of course, with the fact that no special track is needed. Again, while the tramcar is compelled to keep to a fixed course, the trolley 'bus can run on any part of 35 feet width of roadway. When the great increase in vehicular traffic which has taken place during the last few years (and is still going on) is considered, it will be seen that this flexibility of the trolley 'bus is of vital importance if street congestion is to be avoided. Another point which follows is that passengers are set down by the kerbside instead of in the roadway. One of the leading makes of trolley 'bus to-day is the Ransome, made by Messrs. Ransomes, Sims and Jefferies, Ltd., of Ipswich. In the manufacture of their trolley 'buses, Messrs. Ransomes have been able to bring to bear their large experience in electric battery vehicles, of which they were the first British manufacturers. They are also in the unique position of making practically the whole 'bus themselves, including the chassis, the motor, the bodywork, etc., for, in addition to the shops for the metal work, which are equipped with the finest modern machines and appliances, there is a wood-working section where the bodywork is made. As is well known, bodywork for passenger vehicles calls for workmanship and materials of the highest class, and the fact that Messrs. Ransomes manufacture large numbers of bodies for the principal omnibus companies in Great Britain is proof of the excellence of this section of the work. Among their recent orders may be mentioned trolley 'buses supplied to the Municipality of Georgetown, Penang, with bodies specially designed for the use of natives with wooden slatted seats in place of upholstered seats. The whole of the framework is of teak, instead of home-grown woods, and the windows are fitted with sun blinds. These 'buses have the entrance at the rear, and the loading platform is exceptionally low. Messrs. Ransomes have also built trolley 'buses for the Bloemfontein Corporation. These 'buses have both front and rear entrances, rattan seating and both bodywork and chassis, instead of being painted in the usual way, are sprayed by the cellulose process, giving an exceptionally fine and lasting finish. It may also be mentioned that these 'buses, in addition to the ordinary foot and hand operated brakes, are fitted with a specially powerful electric brake, which is operated by the same pedal as the ordinary service brake. Messrs. Ransomes' latest trolley 'bus production is a 6-wheeler with double deck, an order for a fleet of which has been placed with them by the Maidstone Corporation.

Current News.

MR. G. F. FITZGERALD has been transferred to Waltair, B.-N. Railway, as Assistant Transportation Officer.

MR. S. N. GUPTA on return from leave has been placed on special duty to work as an Assistant to the Statistical Officer, B.-N. Railway.

HIS EXCELLENCY SIR CHARLES INNES, accompanied by the Chairman of the Port Commissioners, visited the Rangoon Port on Saturday last.

A TIMBER company is being organised in Mukden, Manchuria, to work the forests in the Tung Pien Circuit. The company is capitalised at £100,000.

MR. R. DORMER, Superintendent, Railway School of Transportation, Chandausi, is appointed to officiate as Principal of the School, *vice* Mr. H. C. Wallance, granted leave for seven months.

THE total approximate gross earnings of State Railways up to 24th December 1927 amounted to Rs. 72·61 crores, or Rs. 332 lakhs more than the figures for the corresponding period of the previous year.

THE HON'BLE SIR JOHN BELL, who represents the Bengal Chamber of Commerce on the Council of State, has tendered his resignation from that body. Sir George Godfrey, it is expected, will be elected his successor.

MR. H. C. EDMONDSON of Messrs. Turner, Morrison and Co., Ltd., whose term of office will expire on 17th January, has been re-elected a representative of the Bengal Chamber of Commerce on the Calcutta Port Commission.

INDIAN merchants trading in London have decided to call their newly-formed organisation the Indian Chamber of Commerce in Great Britain. The present office-bearers will resign at the general meeting to be held in April next.

THE Railway Board have sanctioned the construction by the North-Western Railway Administration, of a line of railway of 5 feet 6-inch gauge from Batala to Butari, a distance of about 42 miles. The project will be known as the Batala-Butari Railway.

BUILDINGS are growing to such a height in the United States that the most recent ones, such as the Mather Building in Chicago, which rises to a height of 553½ feet, have to be anchored down into the ground to resist the over-turning effort of wind pressures.

THE efforts of the Special Committee of the Calcutta Corporation to bring about a settlement of their disputes with the Cleveland Bridge and Engineering Company in connection with the Water Works Extension scheme, it is understood, have failed.

THE total approximate gross earnings of State Railways for the week ending 24th December 1927 amounted to Rs. 220 lakhs, Rs. 1 lakh more than the figures for the last week and Rs. 13 lakhs more than the figures for the corresponding week of the previous year.

THE fourth Machine Tool and Engineering Exhibition is to be held at Olympia from 5th to 22nd September next. It is understood that already the whole of the main hall and nearly the whole of the annexe has been booked by exhibitors, and that a considerable part of the gallery is also let.

ARRANGEMENTS are being made to demolish the great smoke stack, at the works of J. Townsend, Ltd., chemical manufacturers, Crawford Street, Port Dundas, Glasgow. The stack, which was erected in 1857, had an original height of 488 feet and was the highest erection of its kind in the world.

THE Railway Board have sanctioned a preliminary Engineering Survey and Traffic investigation being carried out by the Agency of the East Indian Railway, for a railway line on the 2 feet gauge from Champadanga to Tarkessur, a distance of 6 miles. The survey will be known as the Champadanga-Tarkessur Connection Railway Survey.

A MEETING of the Hooghly District Agricultural Association was held last Wednesday, Mr. R. L. Walker, I. C. S., District Magistrate, presiding. The agricultural problems of the district were discussed, and it was decided to take up irrigation work, and carry on a vigorous propaganda through the Association. It was resolved that a large number of seed farms should be opened.

THE Commissioners of the Naihati Municipality are considering a scheme, known as the Naihati Development Scheme. The scheme provides for the opening of a new municipal market in front of the railway station, the widening of several roads and the extension of water supply beyond the railway lines. It is understood that negotiations for electric lights in the streets will be reopened.

ON the new line which has been constructed to connect Sydney with Broken Hill one of the difficulties that will have to be contended with is, according to the "Industrial Australian," the drifting of sand on to the land, due to heavy winds in dry periods. The N. S. W. Minister of Lands (Mr. Ball) believes that a special form of sand plough will have to be used to clear away this obstruction.

GOVERNMENT OF INDIA

RAILWAY DEPARTMENT

(Railway Board)

NOTICE.

Steel Sleepers and Keys for Broad Gauge Indian Railways.

TENDERS are invited for the supply to **Broad Gauge Indian Railways** during 1928-29 of steel sleepers and keys described below :—

1 Description of sleepers.	2 Description of keys.	3 Quantity required in 1928-29.	
		Tons.	Nos.
Steel, for Broad Gauge 90 R.F.F. rails, 5′ – 6″ gauge, weighing 168 lbs. each.		17,000	226,667
	Steel, for use with sleepers described in column 1.	824	997,350

2. The Railway Board will also consider tenders for equivalent quantities of sleepers and fastenings for use with 90 R. F. F. rails, 5′ – 6″ gauge, to designs alternative to those specified in clause 7 of this notice.

3. The monthly deliveries offered must be stated on the tender form.

4. Simultaneous tenders for the above quantity are also being called for in England through the Director-General, Indian Stores Department, London.

5. Tenderers may quote for the sleepers with keys, or for sleepers or keys only, or for the whole or part of the total quantities required.

6. The quality of material and standard of workmanship must conform to the specifications in every respect.

7. Copies of tender forms, "General conditions of Contract," specifications and drawings can be obtained on application to the Secretary, Railway Board, New Delhi, on an inclusive payment of Rs. 2 per set. If the money is sent by Money Order a reference to this advertisement should be made. This fee will not be refunded.

8. Firms that are not on the approved list for the supply of steel sleepers and keys should support their tenders with certificates from the Indian Stores Department to the effect that they possess workshops and appliances for turning out work of the desired standard and within the period quoted in the tender.

9. No covering letters should be sent.

10. After tenders have been submitted, no representatives of the tendering firms will be granted interviews in connection with these tenders.

11. Tenders must be enclosed in sealed covers superscribed **"Tender for steel sleepers"** and should reach the Secretary, Railway Board, before 4 P. M. on the 28th February 1928, at which time they will be opened by the Secretary, Railway Board, or an officer acting on his behalf, in the presence of any tenderers who may desire to be present, and the quotations will be read out.

12. The tender prices will be for the designs as shown on the drawings, but if any alterations in the designs are found necessary at the time of placing the order or during the execution of the work, the consequent variation in the tender prices will be settled by negotiation.

13. The Railway Board reserves to itself the right to reject any tender without assigning a reason and does not bind itself to accept the lowest tender or the whole or part of any tender.

14. No earnest money or security is to be sent with tenders.

J. KAUL,
Secretary Railway Board.

NEW DELHI,
The *5th January 1928.*

Foreign Notes.

Peruvian Irrigation Scheme.—In order to stimulate the cultivation of cotton and sugar, the Peruvian Government has completed arrangements with a syndicate of financiers for the irrigation of about 130,000 acres of land suitable for cotton and sugar growing, but now lying absolutely sterile. Work is to begin at once on plant for the utilisation of the waters of the Rio Huancabamba flowing at 8,000 feet above sea level. Reservoirs will receive supplies through a tunnel, 11 kiloms. long, bored beneath the Andean Cordillera. The water thus obtained will also serve to irrigate land in the district of Lembayeque, where some of the largest cane mills in Peru are situated. It is also proposed to erect additional mills and re-equip several of those in operation.

French Congress on Industrial Fuels, 1928.—The next session of the Congrés de Chauffage Industriel is to be held in Paris during the first fortnight in June 1928. This Congress. which deals with the production and utilisation of fuels, takes place every five years, and is of considerable interest on account of the influence it exercises in scientific research through the comparisons it permits of recent advances in science and technique, and by the collection of the results of work and experiments carried out which it makes and places at the disposal of engineers. The Congress will be held under the auspices of the Commission Interministerielle d'Utilisation du Combustible, assisted by the Société de Physique Industrielle, which acts as a permanent commission between the sessions The general secretary is M. Pierre Appeln, 5, Rue Michel-Alge, Paris.

Smoke in Furnaces.—Dr. J. S. Owens, in his recent lecture to smoke-inspector candidates, dealt with the methods of smoke prevention in furnaces. The effect of cooling the combustion chamber, and of too great or too small a supply of air, was explained, and the bearing upon the formation of smoke. The fact that a boiler furnace consumes fuel continuously, but is in many cases fed intermittently, was pointed out, to emphasise the value of mechanical stoking as a smoke-preventing measure. By mechanical stoking a continuous feed is provided ; while the need for opening the furnace door, with the accompanying excess air admission and cooling, is done away with. The problem of smoke measurement was dealt with, and various charts used for this purpose were shown on the screen, as well as an instrumental method for the same purpose. Some interesting photographs of dust from different furnaces were also shown.

Iron Suspension Bridge at Marlow.—After doing service for over a hundred years, the iron suspension bridge which connects Buckinghamshire and Berkshire at Marlow has been declared inadequate to support present-day traffic, and it has been decided to demolish it and build a new ferro-concrete bridge faced with stone instead. The existing bridge has a beautiful setting with Marlow Weir and Quarry Woods as a background when facing downstream. It is stated that the new bridge will be a single-span bridge, and it is estimated that the scheme for the demolition of the old bridge and the construction of the new bridge will cost £70,000, and will take two years to build. During that period a temporary bridge will be thrown across the river a little above the present bridge, to take light traffic. To meet the cost of the bridge the Ministry of Transport will make a grant of £45,500. and the County Councils of Buckinghamshire and Berkshire will each contribute £12,250.

The Production of Tool Steel.—There are many minor details of railway working which exercise, in the aggregate, no small influence on working costs, says the "Railway Gazette." Tool steel, for example, affects practically every stage of locomotive construction, enters largely into locomotive maintenance, and is of no small importance, again, in the complicated planing work which precedes the assembly of track crossings and switches. Moreover, the constantly increasing hardness of the raw materials so dealt with—such as the steel of railway rails and tyres—increases the problem of manufacturing a tool steel of sufficient purity and hardness to stand up to the difficulty of performing the necessary work on them. It is not merely the cost of supplying tools that is in question ; but it must be remembered that tools rapidly broken or blunted probably mean that the particular job on which they are engaged is delayed, and that the machine concerned is occupied on that job for a longer time than is necessary or economical.

Two-stroke Aviation Engine.—One of the main drawbacks to the use of a two-stroke aviation engine running on petrol has been, according to Mr. H. B. Taylor, the loss of mixture which occurs through the exhaust port, which loss can only be overcome by an elaborate system of porting, or valve arrangement, or the injection of fuel during the compression stroke. The difficulties met with, however, have been so great that no successful two-stroke aviation engine has yet been developed, and in those types which have shown any promise the simplicity of the normally ported two-stroke engine has disappeared. The compression ignition engine is, however, concerned with the compression of air alone, and the simple ported two-stroke construction does not lead, in this case, to a direct loss of fuel through the exhaust ports. This class of engine therefore lends itself more readily to two-stroke working than does the petrol engine, and when successfully developed may show very favourable weight-power ratios.

An American Ironworks Centenary.—One of the oldest and best-known concerns among the heavy industries of the United States, the Ulster Iron Works of Dover, New Jersey, celebrated its centenary last year. The building of the Company's first mill was begun in the autumn of 1825 at Saugerties, Ulster County, New York, where water power was available from a creek. In 1827 William Young and Henry Carey formed the Ulster Iron Company. The fact that the mill was dependent for transport upon the Hudson River, which was not navigable during the winter months, was a great hindrance to operations, and in 1884 C. R. Mulligan, the manager of the Dover Iron Company, who had 20 years earlier assumed, jointly with his brother William, the management of the mill at Saugerties, transferred the entire plant to Dover. Mr. Mulligan continued as president of the company until 1922, when he was succeeded by his son, John, who died in May 1926, and was followed by Mr. Frank W. Hamilton, the present president. The company specialises in hand-puddled wrought iron for ship rivets, stay-bolt iron, hammered iron billets and drilled hollow iron.

Thames Bridges.—According to the "Engineer" it wood appear that some months more must elapse before the report on the proposed Charing Cross road and railway bridge is ready for submission. The construction of the bridge was recommended by the Royal Commission on Cross River Traffic, and it was estimated that the scheme would involve an expenditure of between twelve and thirteen million pounds. An inquiry into the proposal was ordered, and was placed in the hands of Messrs. Mott, Hay and Anderson, consulting engineers, in conjunction with Sir George Humphreys, the Chief Engineer to the London County Council, and Mr. A. W. Szlumper, late Chief Engineer to the Southern Railway. It is stated on apparently good authority that this Committee will not be in a position to submit a report on the scheme until the spring. It is very unlikely that the London County Council will come to any decision regarding the course to be pursued in connection with the reconstruction or demolition of Waterloo Bridge until the report on the proposed Charing Cross Bridge has been received and fully considered.

Chequer-Work for O. H. Furnaces.—Mr. Fredk. H. Loftus, in a recent issue of "The Iron Age," proposes a simple method of calculating the proper weight of the chequer-work for O. H. furnace regenerators. He suggests using one pound of chequer brick in each air chamber for each pound of steel produced per heat, with not less than 0·06 square foot of exposed surface per pound of chequer brick. The size or capacity of the passages or flues through the chequers, determined by the volume of waste gas, should equal 0·99 square foot per ton of capacity for both the air and gas chambers. The air chamber should have a ratio of two to one over the gas. The flue passage per ton of capacity through the air chamber would be about 1·65 square feet. The flue passage through the gas chamber would be 0·825 square foot per ton of capacity. Under ordinary furnace conditions, with producer gas as fuel, the area of these passages will permit a calculated velocity of 400 feet per minute. To obtain the best results in the upper portion of the chequers, from the standpoint of heat transmission, the total area of the passage should be such that the velocity of the gases entering the chequer will not exceed 600 feet per minute. In the latter case the area of the flue passage per ton of steel produced would be 1·1 square feet for the air chamber and 0·55 square foot for the gas.

Railways and Ferro-Concrete.—The "Railway Gazette" states that Railway engineering and architecture offer a very wide scope for the use of concrete as a material suitable for a variety of purposes. Ferro-concrete is nowadays widely employed for bridge building and also in the construction of stations and other works, and to such a high standard has the manufacture of articles in concrete and ferro-concrete advanced that nowadays the range covered varies from objects weighing as little as a few pounds to as high as several tons, and it is quite likely that these figures are not regarded as the limiting factors. Experiments have been made in connection with concrete sleepers, but in that direction have not apparently been so successful as in others, and presumably this is to some extent due to the fact that sleepers used on main lines are subjected to so many and widely varying loads and stresses. We are not aware of any direct evidence showing that concrete is unsuitable for this particular purpose. But durability of concrete structures, even when exposed to severe climatic variations, has been demonstrated in the most conclusive fashion, and this class of construction has, therefore, the merit of ultimate economy. It seems quite certain that concrete in one form or another will figure more extensively in the future for railway constructional purposes than it does at present.

1,565-lb. Boiler Pressure.—Sulzer Bros., the well-known Swiss firm, built over a year ago, and are now successfully operating, a boiler designed for a pressure of 1,565 lb. per square inch, corresponding to a steam temperature of 707 deg. Fah. Powdered fuel is fired direct from high-speed coal pulverisers. In the high-pressure boiler unit is an 86-square feet radiant super-heater, while the low-pressure boiler has a 430-square feet superheater of usual construction located between the two boiler units ; this may be by-passed if desired. The high-pressure boiler consists of a seamless drum, in which are placed the ends of the U-shaped heating tubes. A smaller drum or steam collector placed above it is connected with it by a number of vertical tubes. The 14 feet long high-pressure drum has an inside diameter of 36 inches, a thickness of 2·9 inches, a thickness at the manhole of 4·6 inches, and an approximate weight of 8·5 tons. The steam collector has an inside diameter of 28 inches, a thickness of 2·08 inches, a thickness at the manhole of 3·35 inches, a total length of 9 feet 10 inches, and weighs 3·4 tons. The feed water is treated in a Sulzer purifier and fed by a low-pressure centrifugal pump against a 206-lb. pressure into the low-pressure boiler. The make-up feed for the high-pressure boiler is about 5 per cent. of the high-pressure steam produced.

The Nice-Coni Railway.—Started twenty years ago, the railway between Nice and Coni in Italy is now nearing completion, and will be officially opened in June next. It puts the Riviera into direct communication with the North of Italy and with Central Europe through the St. Gotthard and Simplon tunnels. On Italian territory, the single track line has been in service for some years, but from the frontier to Nice, a distance of 36 miles, the construction was frequently interrupted, and it was only two or three years ago that a determined effort was made to complete an undertaking which threatened to drag along interminably. In view of its length, the railway offered probably more engineering problems than any other in the country. It has more than twenty bridges, viaducts and other works to carry the railway through a tortuous region of the Alps. At L'Escarène there is a viaduct with eleven arches 40 m. high. Then comes the Braus Tunnel, which is the longest in France, its length being 5,939 m. The Bevera Viaduct has four arches, joining a metallic bridge 90 m. long. There is an important bridge at Saorga and another at Scarassoui, which carries the line across the river Roya at a height of 45 m. Finally there is the spiral tunnel of Berghe, which has a length of 1,886 m. Between Sospel and Breil the line passes through a tunnel under Italian territory, and at Breil a branch line has been constructed to Vintimiglia. An important international station is being built at Breil, while the frontier station will be at Foutan.

General Articles.

THE VALUE OF HIGH GRADE IRON.

TWO STEAM BOILERS MORE THAN A CENTURY AGO.

SOME time ago we made reference to the subject of a well-known British product, genuine best Low Moor iron, which has been manufactured ever since 1791 and possesses striking properties in the way of resistance to fatigue, shock and sudden stresses, and corrosion. As regards the latter important advantage we are now able to reproduce herewith a photograph of two original "wagon" boilers—more than 100 years old—made of this quality of iron that are still doing duty at the Low Moor Iron Works near Bradford, although now in the capacity of water tanks, having been used however under steam pressure conditions of 3—4 lb. per square inch, for over three-quarters of a century.

The wagon boiler was introduced by James Watt about 1780, that is 11 years before the Low Moor works started, being really an elongated "haystack" boiler, made rectangular in plan, instead of circular, to give greater capacity, being manufactured—as well illustrated in the photograph—of riveted plates with an arched top, set in a firebrick setting, with the hand-fired furnace underneath and convex bottom at the front, the flames and hot gases being generally deflected right round the sides. At first the latter were straight, but afterwards a slightly curved form was introduced, also shown in the photo, and these particular boilers are of very large size. Generally the standard wagon boiler set for a 20 horse-power steam engine, as made regularly up to, say, 1825, was about 13 feet 9 inches long, 6 feet 9 inches high, and 5 feet 6 inches wide at the water line, giving a heating surface of approximately 200 square feet, with a water content of about 18,750 lb. and a working pressure up to about 5—6 lb. as a maximum. These boilers at Low Moor, however, are 24 feet 1½ inches long and 7 feet 11 inches wide on the floor level with an over-all height to the top of the dome of 8 feet 9 inches. Also the width at the widest part, about the water level is 9 feet 11 inches and the height inside the boiler from the arched floor to the roof is 7 feet 5 inches.

Low Moor iron was particularly in demand for the wagon boiler, and other early designs as well, because of the remarkable resistance to corrosion, entirely different, of course, in this respect to steel. As seen, the plates of the two wagon boilers in question are still in an excellent state of preservation to-day after a century, while there are many cases known of "Cornish" and "Lancashire" boilers made of Low Moor iron that have been in continuous use for steam generating purposes for over 50 years. Also in the firm's Museum at Bradford there is a stay-bar taken out of another "wagon" boiler, also over 100 years old and in use all the time, which is still 85 per cent. of its original cross section, although bad colliery water of 26° total hardness was used. A steel bar would, of course, have been dissolved over half a century ago and there is no question that for many purposes in these modern times of speeding-up that the use of genuine Low Moor iron is a paying proposition.

DESIGNING LINED CANALS.

IF earthen canals are to be lined with concrete, in the future, to prevent losses of water by percolation and absorption, it would appear that the outline requires as much attention as the method of construction.

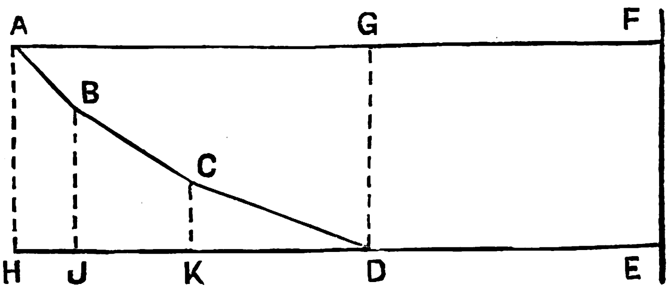
The Pyramid Kennedy Formula, already noticed in the Notes and Comments columns of INDIAN ENGINEERING, bases the equation on the proportion f_p, between the assumed final area of the section and the final length of the wetted perimeter, both factorized to y. This proportion, in such factorized units, is $3(x+5):(x+12)$; and for m_p in foot-units is $3(x+5)y^2:(x+12)y$.

The last thing an engineer wants, whether in a lined or unlined canal, is an eddy, or local disturbance in the flow. Such action long continued may disclose a weak spot and cause serious mischief before detection. It would be still more serious if a bad outline created a series of eddies.

A common method of lining a canal is to construct it on the usual trapezoidal form, and then to lay six or eight inches of rather poor concrete on the level bed and the sloping banks. If the canal had been left unlined, the action of flow would have changed the wetted outline, rounding off all angles, and leaving no plane surfaces. It follows, therefore, in the lined canal, if the angles are to remain sharp and not filled and rounded off with silt, and the planes of bed and sides are to remain clear of all deposit, that the velocity of flow must be considerably higher than the ordinary critical mean velocity of an earthen channel. The concrete lining will be subjected to a scouring current; and since expense is an important point, it is reasonable to suggest that there should be also a critical mean velocity for average concrete lining, with high and low limits to suit superior or inferior materials and execution.

The writer suggests therefore that the correct way to prepare the preliminaries for a solution is to draft a large number of sections in factorized dimensions for easy comparison, and by trial and error, every one in the proportion $3(x+5):(x+12)$, the last being a "curved" line well flattened out on the bed-level of the channel. It ought then to be easy to excavate and bank and lay the lining on a near series of slopes, which would make all the angles in the section obtuse, that is, as large as is possible over a right angle.

Since the engineer would not be dealing with shifting earth under the action of water, but with concrete, presumably capable of resisting erosion, the following method might be suitable :—



The above figure represents a half-section of the proposed lined canal, on the centre-line FE. [The figure is to no scale and much distorted for clearness.] Let, in factorized units, DE = ½x, EF = 3, and AG = 5. Then, to meet the conditions of the equation, AB + BC + CD = 6 units. If now, A is joined to D, the length AD = 5·831, and the solution is seen to be not practicable. If, however, CD + DE is taken as = ½x, C coming vertically below G, AG as before = 5 units, then a very pretty little solution is possible, which the writer will leave to the reader, not to spoil his interest in this article. It will repay the reader to attempt it, and since there are more ways of doing it than one, perhaps some interested reader will communicate his solution to INDIAN ENGINEERING. It is necessary to begin by considering the various angles in terms of the tangents; after which an easy geometrical construction is found; that, at any rate, is the writer's solution, but there are others, perhaps easier and better.

Having succeeded in this manner in securing the necessary series of sections which all offer m_p as the true hydraulic mean radius, it seems easy to adjust the V_0 for the linings which may be adopted with high and low limits of C_0.

Σ. Φ.

THE NEW KIRKSTALL ELECTRICITY STATION FOR LEEDS CORPORATION (ENGLAND).

IMPORTANT CONTRACT NOW SETTLED, WITH HIGH PRESSURE STEAM AND PULVERISED FUEL FIRING.

THERE has now been placed by the Leeds Corporation with International Combustion Ltd., of London, a contract of the value of £202,114, for the complete equipment of the first section of the boiler house at the new Kirkstall Electricity Station. This includes three very large "Stirling" type water tube boilers, with forged steel drums, of a normal evaporation of 160,000 lb. of water each per hour, operating at 490 lb. pressure and 750° superheated steam temperature, fired throughout by "Lopulco" pulverised fuel on the latest principles. Also large self-contained "Raymond" centrifugal roller mills of the usual air separation type are to be provided along with the new rotary dryers for the raw coal, operating direct with the pulverisers, and in the combustion chambers, water screens and water cooled walls on the "Murray-Usco" principle of 4-inch steel tubes in series with the boiler, giving a very high radiant heat absorbing capacity. Also there will be fitted the new "R Type" burner, one of the most striking achievements of the Research Department of International Combustion Ltd. carried out at Barrow, on the turbulent principle, whereby 150,000,000 B. Th. U., say 5-6 tons of coal, can be burnt per hour by a single burner, while the flame is only 10 feet long instead of the usual 30 feet as in previous pulverised fuel practice. This means that the combustion chamber is now very little larger than for mechanical stoking, while 2-4 burners only are required per boiler. Also at Leeds each boiler will have feed-water economisers, "Usco" air heaters, dust extraction apparatus, induced draught and short steel chimneys, and there is included in addition all the conveying plant for handling the raw coal from the barges to the pulverisers, or storage dump, and also the pulverised coal and the residual very fine ash.

This contract, following on many others obtained by International Combustion, Ltd., including the new Hams Hall Station, Birmingham, for the sum of £1,458,000, the largest power order ever placed in Great Britain, the second section of Barling Electricity Station (London), Derby Corporation, Poplar Borough Council (London), St. Pancras Borough Council (London), Synthetic Ammonia and Nitrates Ltd., Billingham on Tees, York Street Flax Mills, Belfast, Ashington Collieries on the N. E. Coast, Pilkington Bros., St. Helens, and many others, proving that "Lopulco" pulverised fuel has now become standard practice in Great Britain. A plant such as that for Leeds will run continuously at practically 90 per cent. steam generation efficiency, an amazing figure with about 26-27 per cent. thermal efficiency from the raw coal, comparatively few power stations in the world being over 20 per cent., and the average is certainly less than 15 per cent.

Altogether "Lopulco" plant now running or in course of erection in Great Britain, not including Leeds, totals 450,000 tons of coal per annum capacity, and although International Combustion Ltd. of London, only commenced operations in 1924 to design, supply and erect complete power plant, they have already secured contracts to the value of over £7,000,000 and at present the unfilled orders on the books exceed £3,000,000.

Apart from Great Britain and the United States some recent outstanding contracts have also been the Vitry and Gennevilliers power stations, Paris, the new Klingenberg station at Berlin, the Congella station at Durban (South Africa), the Perak steam station in connection with the Perak hydro-electric scheme in the Malay States, and the new extensions at Shanghai Electricity Station.

BACK BAY.

HARVEY-NARIMAN SUIT.

RESUMING his address in the libel suit on the 24th December, Mr. Nariman traced the alleged relations which existed between Mr. Harvey and the Bombay Construction Company and the Ferro-Concrete Construction Company in connection with the chawl contracts. Major Parcelle, he stated, who was working in the Development Department, resigned when tenders were to be invited for 80 chawls and joined the Bombay Construction Company as a partner, giving an undertaking that he would secure the contracts to the extent of Rs. 80 lakhs within a year. The Company tendered for 80 chawls and their tender was accepted, though their quotation was Rs. 13,000 more per chawl than the lowest tender. Mr. Harvey's reason for granting this contract could be only to fill private pockets.

Mr. Nariman declared that it was nothing but the presentation of purses to Mr. Harvey's personal friends out of public funds.

Mr. Nariman then referred to the dealings of the Development Department with Gaya and Company, and the alleged payment of commissions by that firm to officers of the Department in respect of contracts for chawls.

On the 27th December Mr. Velinkar opened arguments on behalf of the prosecution. He drew attention to the "persistent campaign of vilification" indulged in by the accused against the Development Department, its officers and Mr. Harvey in particular. Desire to please the electorate and play to the gallery led to the accused introducing a lot of irrelevant matter. The purpose of the inquiry, said Mr. Velinkar, was not to go into the internal management of the Department.

Mr. Velinkar cited authorities to show that repetition of rumours was not excusable under law. He read portions of Mr. Nariman's evidence before the Back Bay Enquiry Committee to prove that accused had Mr. Harvey in mind when he made the allegations. Even if it were held that Mr. Harvey was not meant it did not matter at all. In law he cannot escape by saying he intended somebody else.

Counsel referred to accused's lack of good faith in persisting in his libel and at the quibbling and turning round by saying he referred to the whole Department.

Resuming his address on the 29th December Mr Velinkar said he was willing to concede that on the facts Mr. Nariman was entitled to conclude ⅞ inch bars were wrongly ordered, but bars could be wrongly ordered for various reasons, but Mr. Nariman chose to ascribe ulterior and corrupt motives A mistake may not mean a corrupt or dishonest mistake. Mr. Nariman had not exercised due care and attention in imputing dishonesty. Counsel explained how it was a justifiable inference of Mr. Harvey that the ⅞ inch bars were being used.

As regards three important documents being missing, Mr. Velinkar said it was all owing to Mr. Hamid, who removed most of the documents he could lay his hands on that would lay the fault at his door. This he probably did when acting in Mr. Harvey's absence. It was not correct to say that Mr. Harvey deliberately suppressed them, for this was of no use to the prosecution.

Mr. Velinkar referred to the insinuation about "grouping of officers" in the Department. Mr. Harvey did not apply for the Superintending Engineer's job: he was cabled to to accept when he was in England. Sykes and Hamid were taken on owing to their experience of construction works in Delhi.

The true facts about Mr. Harvey and Mehta not being able to pull together were that Mr. Harvey did not want Mehta to be dismissed and asked Government to give him a chance. But the latter asked him to

leave. Counsel added that he feared that Mehta was Mr. Nariman's evil genius.

Mr. Nariman : There is no evidence to show that?

Counsel : That is my suggestion.

Mr. Nariman : That is another theory.

Mr. Velinkar said the missing documents and registers relating to Unwalla were in Mehta's charge and could not have been suppressed or destroyed by the prosecution.

Counsel said the defence suggestion that, owing to the alteration in design the chawls lost two rooms in each floor was a myth, as the loss in each room was about two or three inches.

Counsel said Major Parcelle was not in the Development Department but in the Military Land Scheme. He resigned to better his prospects and joined the Concrete Company as a partner. The large sums found in the Major's bank account were proved in the evidence to have been his share of profits under the terms of partnership.

Resuming his arguments on the 30th December Mr. Velinkar examined the documents connected with the Ferro-Concrete Company's contracts and said that when Mr. Survello resigned from the Improvement Trust Mr. Harvey was on leave. The original contract was for 16 chawls, but later, owing to the blasting of a hill near the site, the number was reduced to 12. A compensation claim was put in for Rs. 56,000 and complainant recommended Rs. 36,000. The Deputy Financial Advisor objected, overlooking the fact that the original contract was for 16 chawls. Eventually Rs. 36,000 was passed after long correspondence.

Questioned as to why the contract was given to the Ferro-Concrete Company, counsel said it was owing to Mr. Survello's connection with it and his vast experience.

He said the overpayment of Rs. 14,000 for painting windows was a purely *bona fide* clerical error, "as happens in all well-regulated departments even."

Mr. Harvey wrote to the Ferro-Concrete Company to put in a compensation claim, because the matter had been dragging on from 1923 and he wanted to fix them to a particular figure to prevent exaggerated claims later. Accidentally Mr. Survello and Mr. Harvey sailed together, and on this flimsy ground Mr. Nariman had based his allegation of favouritism.

Six tenders were received for 30,000 bars. The contract was given to Salebhoy Tyabji owing to urgency. The firm was fined Rs. 6,000 for late delivery. This did not look like collusion. The most that could be said was that there was a lack of judgment in placing the order locally without ascertaining the prevailing rates from the Chief Commissioner.

As regards the entry in Gaya and Company's books, Mr. Velinkar contended that Mr. Gaya had not come forward to give evidence. There was nothing to show that bribes were paid to Mr. Harvey.

The recording of evidence was concluded on the 31st December 1927. Simultaneously with the conclusion Mr. Harvey sailed for England on nine months' leave by permission of the Court.

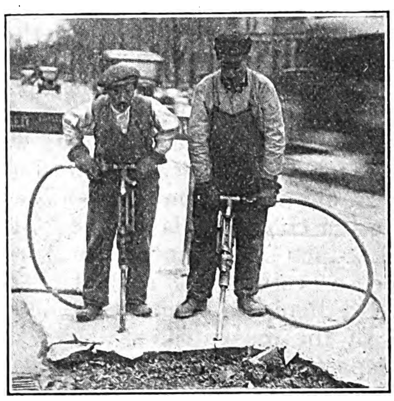
Mr. Velinkar dealt with Mr. Trivedi's evidence. He was a sort of partisan of rather doubtful veracity. His narrative of his brother's conversation with Mr. Jivaraj was inadmissible and should not be taken into account. Mr. Joseph Brooks was a most disreputable witness, an impecunious unrepentant gambler who sought discharge from the Back Bay Development Department.

Counsel spoke of the difficulty of public servants in vindicating their character in the face of aspersions by citizens who could use the Press to explain and defend themselves.

The Magistrate reserved orders and adjourned the case *sine die.*

PNEUMATIC TOOLS.

PNEUMATIC TOOLS are being used in steadily increasing numbers in the carrying out of municipal and public works, and engineers and contractors for these undertakings will be interested in several new publications concerned with these appliances which have just been issued by the Consolidated Pneumatic Tool Company, Limited, Egyptian House, 170, Piccadilly, London, W. 1, with offices at Calcutta, Lahore and Bombay, also branches all over the world. The publications in question include the company's latest electric tool catalogue (No. 14), and literature upon the following :—Pneumatic paint scraper and scaling hammer (S. P. 113); new type No. 33 Little Giant grinder (S. P. 124); pneumatic hammer coal pick (S. P. 126).



DEMOLITION TOOLS IN OPERATION.

In demolition work of all kinds costly and laborious hand methods are everywhere being supplanted by air-operated tools, conspicuous examples of the directions in which they are employed with the greatest advantage being in connection with the tearing out of concrete and brick foundations and walls, the cutting of road surfaces, trenching, tamping, back filling, and the driving of sheet piling. For heavy demolition work the Consolidated Pneumatic Tool Company, Limited, have introduced a tool (CP-114) which weighs 74 lb., and which has been designed to meet the severest conditions. Owing to its fast, powerful blow, the cutting capacity of this appliance—which is illustrated herewith—is very great, and it is recommended for use where weight is not so much of a factor, and where the air-pressure is apt to be below 80 lb. The CP-114 is of the valveless type, and is symmetrical in design and well-balanced, and it has only one moving part—the piston. It is essentially an all-steel machine of bolted construction. Carefully selected materials, special heat treatment, workmanship of the highest order, rigid inspection and severe tests, insure proper functioning of the tool, absolute interchangeability and long life of parts. Automatic lubrication is provided, the oil reservoir being in the handle.

ELECTRIFYING THE WORLD.

BRITISH GENERATING PLANT FOR OVERSEAS.

AS illustrating the rapid development of the uses of electricity in many parts of the world, details of some recent contracts secured by one of the leading firms in the British Electrical Industry are of particular interest at the present time. These include a number of important overseas orders for Turbo-alternator sets, to such widely disposed destinations as Melbourne, Singapore, Calcutta, Colombo and Shanghai.

The order for the latter for instance is for a 20,000 k.w. set with condenser for the Riverside Power Station of the Shanghai Municipal Council. The new set is for operation at 3,000 r. p. m., being a duplicate of the last set installed. It is the third set of this capacity to be supplied by the Metropolitan-Vickers Company for the Riverside Power Station and it will bring the plant capacity of the station to a total of over 160,000 k.w.

Mr. T. H. U. Aldridge, M. I. E. E., M. I. Mech. E., the well-known Engineer-in-Chief and Manager of the Municipal Undertaking, who has been responsible for its progressive development, is at present on a visit to England.

A 12,500 k.w Turbo-alternator set has been ordered for the Yallourn Power Station, near Melbourne, where five Metrovick sets of this capacity are already in operation. As in the case of the sets already installed the condenser for the new set will be constructed in Australia by Messrs. Thompsons Engineering and Pipe Company Ltd., to the design of the Metropolitan-Vickers Electrical Company.

Again the Calcutta Electric Supply Corporation, Ltd., has ordered a 12,500 k.w. Turbo-alternator set with condenser for the Cossipore Power Station. This will operate at 3,000 r. p. m. and generate at 6,600 volts 50 cycles.

The Singapore Power Station is of comparatively recent but rapid development. The existing plant consists of two 5,000 k.w. and one 2,000 k.w. Metrovick Turbo-alternator sets, and a new set of 10,000 k.w. capacity has now been ordered by the Municipal Commissioners. All the sets are of the high speed type operating at 3,000 r. p. m. and generating at 6,000 volts 50 cycles.

On behalf of the Ceylon Government the Crown Agents for the Colonies have placed orders which cover the complete equipment of a new power station which is to be built at Kolonnawa, near Colombo. The initial plant is to consist of two 3,000 k.w. Turbo-alternator sets designed for 3,000 r. p. m. operation, generating at 11,000 volts 50 cycles. The orders include the supply of condensing plant, switchgear, auxiliary transformers, crane and boiler plant, the latter being supplied by Messrs. Babcock and Wilcox as sub-contractors.

An interesting indication of the progress which has been made and the work which is being done by British Manufacturers is given by the wide range of sizes under construction. Generating plant in course of manufacture at the Metropolitan-Vickers Works ranges from sets with single alternators of 55,000 k. v. a. capacity for large power stations, down to sets of 100 k.w. for industrial applications.

BRITISH ENGINEERING PROGRESS.

(By a Special Correspondent.)

London, *22nd December 1927.*

British Exports Rising.

The month of November was an encouraging one for British manufacturers for it showed a sharp rise in the value of exports to the highest point since July 1924. Compared with the figures for November 1925, the increases of £1,054,000 in the export of iron and steel, and £1,500,000 in machinery are particularly satisfactory. Among the other industries which all contributed towards the improved results were electrical goods and apparatus, chemicals and motor vehicles.

In the autumn of 1925 there were very definite signs of a coming trade revival, and it was only owing to the shadow of the industrial troubles of 1926 that it came to nothing. The losses caused by the prolonged stoppage in the coalfields were colossal, and it says much for the marvellous resiliency and vitality of the country's industries that, within so short a period, a comparison of the trade returns for October and November 1927 with those of the same months in 1925 still shows an upward trend, while the general price level is now considerably lower than it was two years ago.

Modernising Colliery Plant.

A very considerable programme for the modernising of colliery plant is gradually being carried out in the British coalfields. In many places electric machinery is superseding the old steam plant, resulting in higher efficiency, greater cleanliness and saving of labour and space.

The largest electric winder at present installed in Britain is an equipment of 3,000/7,500 h.-p. at one of the Carlton Main Colliery's pits near Doncaster. This equipment, which was supplied by the Metropolitan-Vickers Electrical Co., consists essentially of a double unit D. C. motor direct-coupled to the winding drum and controlled on the " Ward-Leonard " principle and a fly-wheel motor generator set, by means of which power is taken at 3,000 volts 50 cycles A. C. from the Company's power plant and supplied as direct current at 1,000 volts to the winder motor.

The depth of the shaft is 2,610 feet, while the weight of the cage and chains is just over 17,000 lb., the output per hour being 300 tons. The set is capable of dealing with a maximum peak of 7,500 h.-p. and of sustaining an overload of 25 per cent. for two hours. Its solid steel fly-wheel is 12 feet in diameter and weighs 23 tons. The wheel is provided with a planished steel guard over its upper part, the lower portion running in a pit in the foundation, thus reducing air resistance to a minimum. The energy delivered by the wheel during a 15 per cent. drop in speed is 45,000 h.-p. seconds.

One of the most progressive and enterprising industrial concerns in Great Britain is the Staveley Coal and Iron Co., Ltd., whose works near Chesterfield now cover about 250 acres, apart from the collieries which the Company owns in various parts of the country.

In addition to the mining of coal and the manufacture of cast iron pipes, the Staveley Company has a huge output of by-products of various kinds. Thus the output of sulphate of ammonia, which is so widely used as a fertiliser, is over 5,000 tons per annum. Benzole, which is particularly suitable for the manufacture of dye-stuffs, will shortly be produced at a rate of over 80 thousand gallons a month. Again, the distillation of tar at the Devonshire Works is carried out on an extensive scale, 35,000 to 40,000 tons being dealt with annually.

At those works the waste gases from the furnaces and coke ovens provide all the power and steam required ; three of the largest gas engines in the country, of 7,150 h.-p. each, are employed for the generation of electricity. Some idea of the size of these engines may be obtained from the fact that each crankshaft, stripped of its fittings, weighs about 68 tons.

Designing for Special Conditions.

Mining conditions call for particularly robust construction in electrical machinery and the machines designed for this class of work often differ considerably from the ordinary commercial type motors.

Firms which have made a study of the requirements in the coalfields are now reaping the benefit in the form of considerable orders. Greenwood and Batley, Limited, of Leeds, for instance, made the first pair of enclosed-type coal cutter electric motors nearly 30 years ago, and have been supplying both direct and alternating current motors to some of the largest makers of machines ever since.

The use of conveyor belts for carrying hot materials has in the past been somewhat restricted, owing to the short life of the belts. A new development, therefore, in this direction for which Bell's United Asbestos Co. are responsible is particularly interesting.

For transporting hot materials, such as clinker or smalls, a new type of belt has been designed which combines the advantages of a fireproof Asbestos surface actually in contact with the load and the proved efficiency of a duck material for the roller surface.

The suitability of various kinds of metals for use in highly corrosive mine waters presents a number of problems to the engineer.

Comparative trials have been made from time to time and afford useful data for the student of such problems.

In the case of tests made with steel, iron and Delta Bronze No. IV, the highly successful non-ferrous metal which is to be found in so many branches of engineering to-day, the latter came out victorious. After 6½ months the Delta Bronze showed a loss in weight of only 1·2 per cent. against 46·3 per cent. for wrought iron and 45·45 per cent. for steel. In another corrosion test a loss of 4·43 per cent. was shown in Delta Bronze compared with 19·89 per cent. in Manganese Bronze.

However resistant to corrosion, no non-ferrous metal would be a suitable substitute for iron or steel without strength and malleability. Here again, however, Delta Bronze occupies a favourable position, for its strength is equal to that of mild steel with an elongation of from 20 to 30 per cent. Its malleability is proved by the fact that it can be extended in any form or shape.

Welding Stainless Steel.

While on the subject of non-corrodible metals it is interesting to record the remarkable progress made in recent times in the range of metals and alloys which can be welded satisfactorily by means of the electric arc. A few years ago it was not considered possible to weld stainless steel, but the problem was tackled and overcome by Alloy Welding Processes, Ltd., who produced a stainless steel electrode which gives entirely satisfactory results. It is certainly not possible to weld stainless steel satisfactorily by using wire of the same specification as the metal to be welded as the core for the electrode. The electric arc is the determining factor as it alters the condition of metals very materially, with the result that the metal deposited forms a weld that may be found to be dangerously altered.

Corners of vessels which have to be welded are particularly open to attack by liquids, so that if these parts are low in the metals possessing the non-corroding effect, trouble may occur. It is clear, therefore, that the most careful selection of suitable electrodes is essential in order to obtain satisfactory and lasting results.

The Heat Treatment of Metals.

For the heat treatment and melting of metals a considerable advance has been made by the latest developments in the industrial application of surface combustion.

In the Cox system of surface combustion much of the success turns upon the use of an improved form of porous material, which, in action, becomes incandescent. The substance now employed and known as Cox's Ignite Combustor is a hard granular fireclay-like material that can be moulded into any desired form before it is fired.

Surface combustion, of course, affords a means of heating which is exceptional in several respects. For example, the combustion is complete, no smoke or objectionable fumes being produced. The regulation of the heat emitted can be made either instantaneous or graduated, it can easily be operated automatically either by some timing device or under thermostatic control. The principle has been applied not only to town gas, but to petrol-air gas, producer gas and oil gas, and its applications in the hands of the Metropolitan Fuel Co. of Westminster have already been extended to the manufacture of sweetmeats and biscuits, to the tobacco industry, clothing and textile industries, apart from various more obvious uses such as heating water and raising steam in boilers.

As an instance of the efficiency obtained in an independent test on a surface combustion water heater, an efficiency of 93·6 per cent. was obtained under not very favourable circumstances, reckoned on the net calorific value of the gas.

Huge Products of British Engineering.

To revert once again to the subject of mines, the steel works of William Beardmore have recently turned out what is believed to be the largest drum-shaft ever manufactured. It is intended for an electrically-driven winding engine in the City Deep Mine in South Africa. The shaft will carry two drums each 35 feet in diameter and 350 tons in weight. Each of the winding cables weighs 18 tons; the shaft is driven direct by motors 20 feet in diameter, weighing 300 tons and capable of dealing with a peak load of 9,240 h.-p. This apparatus is designed to raise 9½ tons of ore from a depth of 4,500 feet, the winding speed being some 60 feet per second.

The shaft weighs, when complete, 92 tons and required for its manufacture an ingot weighing 120 tons.

It would appear that the South African mines must contain a considerable amount of British machinery of "record" size, for it may be remembered that about a year ago the Durban Navigation Collieries ordered one of the most powerful mine fans from Davidson and Co. of Belfast. This Sirocco fan has a capacity of 700,000 cubic feet of air against a resistance of 7 inches water gauge and requires a 1,200 h.-p. steam engine to drive it. When working at full load the fan moves no less than 3,400 tons of air through the miles of underground air passages every day.

Mention of these huge products of British Engineering Shops calls to mind the new installation at the Shorts Gardens Generating Station in London. This includes what is the largest heavy oil engine in Britain. It is of 1,750 b. h.-p. and is of the well-known 6-cylinder Fraser-Chalmers type, made at the Erith Works of the General Electric Co., and is particularly remarkable for the fuel economy effected and low maintenance costs.

With fuel at £4 a ton and a load factor of 70 per cent. it is possible to generate current at just under one half-penny per unit, including lubricating oil, wages and repairs. This is due to the design of the engine, as a result of which the amount of fuel doing useful work is 35·5 per cent. of that put in, the remaining loss going in exhaust gases, cooling water and radiation. The best average for a steam plant of 5,000 k.w. and over is about 18 per cent., while below this output the efficiency is about 15 per cent.

Every endeavour has been made to meet any emergency which may arise during the working of the plant. Thus, if the lubricating oil pressure falls below the working pressure an alarm bell is sounded; giving the engineer time to get the load transferred and, should the pressure continue to fall, the engine automatically comes to rest.

The dimensions of the new set when compared with the older types of engine at the same station are much smaller, and it is surprising to find that the new plant has actually three times the power of the old.

The Gazettes.

Bihar and Orissa, December 28, 1927.

Public Works Department.

Mr. F. Sims is appointed as Electrical Engineer, Bihar and Orissa, on probation for one year, with effect from 17th October 1927.

Irrigation Department.

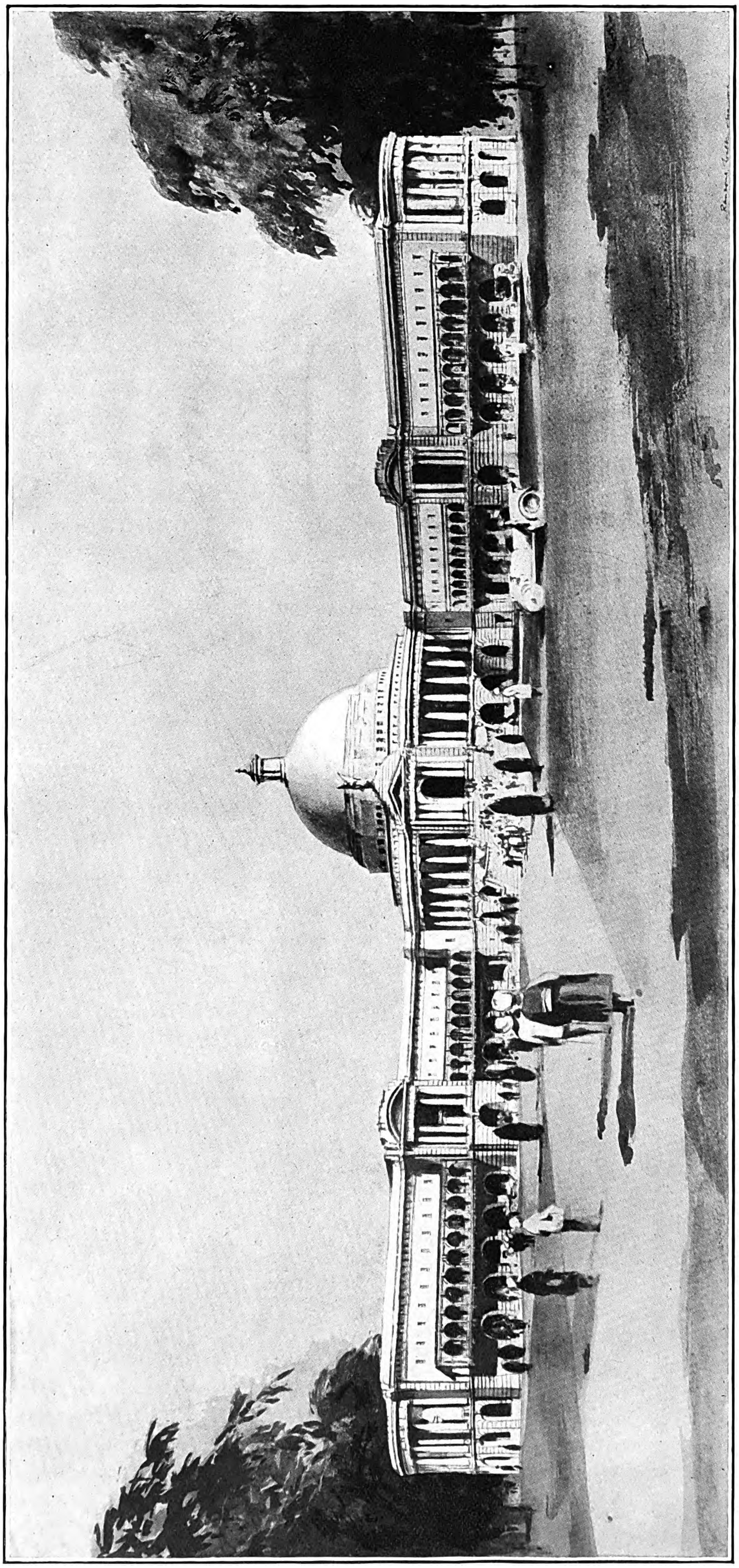
The following notification, issued by the Government of India in the Department of Industries and Labour, Public Works Branch, is republished for general information :—Mr. Desraj Mehta, whose appointment to the Indian Service of Engineers as an Assistant Executive Engineer on probation was announced in this Department's Notification No. E-55, dated 25th February 1927, is confirmed in his appointment.

Punjab, January 6, 1928.

Irrigation Branch.

Mr. Allin Ferrie, Executive Engineer, on transfer from the Islam Division, 3rd British Circle, Sutlej Valley Project, which he left on 12th November 1927, joined the Madhopur Division, Upper Bari Doab Canal, on the 17th idem. Mr. Ferrie took over charge of that Division on 19th November 1927, from Mr. C. H. McKenna, Assistant Executive Engineer, transferred.

Mr. W. E. Flewett, Deputy Conservator of Forests, Punjab, is temporarily transferred to the Public Works Department, Punjab, Irrigation Branch, with effect from 29th November 1927.



COMPETITIVE DESIGN FOR BENGAL COUNCIL CHAMBER, CALCUTTA.

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CONTENTS

INDIAN ENGINEERING.

SATURDAY, JANUARY 21, 1928.

RANSOME AND VERANDAHS.

"VERANDAH-LESS DELHI," as New Delhi has been called, is not a term of praise, and it is a sad reflection on the greatest building scheme of India that a tenant, a sufferer, of one of the official quarters should have said: "Let us have bad architecture and the P. W. D. rather than good architecture and architects." The absence of verandahs is not the only point in the general condemnation of the residences, but it is a point of some importance, and inasmuch as forcible attention was drawn to it on the occasion of Sir Herbert Baker's lecture at the Royal Institute of British Architects last November, it will not be amiss to make some further comments on the subject. Whatever may be said about the failings of the designs of British architects, due to their unfamiliarity with the climate and other conditions of India, it has to be admitted that more was done for verandah-design on the right lines by a British architect, Mr. James Ransome, the first Consulting Architect to the Government of India, than by any architect or engineer in the country.

It did not take Mr. Ransome long, after his arrival in India, to realise that, while there was a tendency to erect buildings in the styles and upon the lines of those found suitable in England, there were difficulties attendant on the achievement of successful buildings of that class in India. He recognised that there must be verandahs, and that being so he also recognised that the appearance of the buildings must necessarily be largely dependent on the verandah-treatment. The problem therefore was to design verandahs, protecting the main walls of a building from the sun's rays, without detriment to appearance and comfort. With that aim in view, he instituted a competition, inviting proposals for the exterior treatment of a building in the plains of India, and the conditions were that the sun should not strike upon any of the habitable rooms at a steeper angle than 40 degrees, and that ample light and ventilation should be provided to all rooms. It was significant of the difficulties imposed by those conditions that out of over fifty applications for particulars of the competition, only twenty-eight designs were received. The competition was nevertheless worth while, for some of the diagrams were both ingenious and useful in their suggestions, and in the light of them, carrying his studies further, Mr. Ransome arrived at a definite theory for verandah-design, which he applied to all the styles in which he was instructed to work. He applied it to the Gothic, as in the instance of his design for the

Lucknow Church, one of the best of his designs; to the Classic, as in the instance of Wellesley Place at Calcutta, a treatment of great originality; to the Renaissance, as in the case of the large Agricultural College at Pusa; and to the English Cottage style, as in the case of the Cadet Corps Buildings at Dehra Dun. In all these instances, he was working to recognised styles and to orders; but later, when he had come to the conclusion that the policy of attempting to adhere strictly to tradition was the keynote of much of the architectural failure of the past and he was allowed a freer hand, he gave himself more liberty, and his designs for the Secretariats at Nagpur and Dacca are notable examples of the latest periods of his work. In all these instances, he achieved his aim, the aim of a verandah-treatment which would afford a maximum protection from the direct rays of the sun, without sacrifice of external architectural effect; and it is not too much to say, as has been mentioned above, that he taught his fellow-builders in India more about verandah-design than anyone else. Nor were the lessons he desired to teach thrown away, there were other consulting architects in India who took advantage of them to a greater or less extent, but at New Delhi they would seem to have been entirely disregarded.

The verandah has two functions, to protect the interior of a building from excessive heat and to afford certain conveniences of life in countries where there is the verandah-habit. Mr. Ransome may have concerned himself almost entirely about the former, but the verandah-habit is a point which is not to be overlooked in any country of bright sunlight, whether the heat is excessive or not. In England, which is, generally speaking, a cold country with grey skies, there is usually no necessity to guard houses against heat, and verandahs in gloomy weather have the disadvantage that they exclude light. But even in England, in a warm summer, verandahs would be welcomed, as is shown by the use made of a loggia when there happens to be one. In countries with bright skies and floods of sunshine, verandahs are always welcome; they are a protection against great heat, and when the heat is no more than enjoyable, the verandah is the best place to enjoy it. In England, it is only because the weather is inclement for the greater part of the year that the verandah-habit has not been acquired; and because that habit does not obtain, British architects have not been accustomed to think in terms of verandahs. It then follows that when they have to design buildings for countries with tropical sunlight, they shy at verandahs because they find a difficulty in expressing a sufficient feeling of solidity in a building of which so large a proportion of its main walls must be concealed. India is a verandah country, but at New Delhi the architects, instead of applying their architectural skill to a verandah-treatment of design, preferred to avoid verandahs and to explain how by other devices they had arranged to afford protection against heat, which is certainly one but not the only desideratum. It is for that reason that an illustration is given of a design for the Calcutta Council Chamber, in which a verandah-treatment has been adopted with charming effect. The design is by Messrs. Ransome, Walker and Harwood, and was one of those submitted in open competition for the purpose in question some few years ago. It did not win the award, though it deserved to win, but the point that it is desired to emphasise is that in this design the verandahs are treated as a continuous shaded balcony, the walls behind being practically all window, that is, there is a window at the back of each arch. The high colonnades are used as Sir Herbert Baker used them at New Delhi, but with this difference that they are used in this case only where the verandahs are very deep and where the rooms are not dependent for light on the colonnaded verandahs, so the colonnades would not have to be blocked by louvred screens. The walls above the balcony verandahs are hollow, and the clerestory openings in them are shaded with stone louvres. The plan is star-shaped, and all the larger rooms are open to the air on two sides. The design appears to be admirable for the Calcutta climate, and the illustration shows that continuous verandahs have been employed, instead of avoided as at New Delhi, without any sort of sacrifice of external appearance. There would therefore seem to be no reason why the architects of the new capital of India should have regarded the continuous verandah as a feature which would mar the architectural beauty of their designs.

WOODS *VERSUS* KENNEDY.

LAST September, we brought to the notice of our irrigation-engineer readers an article published in "The Engineer," entitled "A New Hydraulic Formula," by Mr. F. W. Woods, C. I. E., in which the author produced a set of revised formulæ in supersession or improvement of Mr. R. G. Kennedy's V_o formula; and the subject is so vastly important that in the fresh light thrown upon it by our contributor J. F., in the article we now publish in our General Articles columns, no excuse is needed for returning to it. J. F.'s article is valuable as it helps to clear the air as regards the meaning of V_o, a point on which there has been some misapprehensions, and as the younger generation of irrigation engineers found Kennedy's formula in use and most probably have not stopped to consider it in all its bearings, J. F.'s exposition of its general principles, as well as its limitations, cannot fail to be of great service in the discussion.

Mr. Kennedy, it should be remembered, produced a set of Hydraulic Diagrams after the publication of his formula on which he showed lines for V_o and for different ratios of V_o, such as $1{\cdot}1\ V_o$, $0{\cdot}9\ V_o$, etc., both greater, and less than the Standard. And it is evident that he could only have drawn these lines with the help of an elaborate table of discharges or else by finding a general law for the velocity and in an exponential form. But however that may be, the article under reference shows how it is possible to arrive at such a general

law with fair approximation, and by means of it to explain the essential principle of the V_0 equation, *viz.*, *that in self-adjusted channels there is a definite surface slope for each ratio of width to depth.* The Table illustrates this and shows that the greater the ratio of width to depth in a channel the less steep the slope may be for silt-equilibrium. This of course is well understood to be the general principle underlying the Kennedy formula, but the article also shows the steepest and the flattest slopes permissible for such channels, or in other words, the limits imposed by V_0 which are not so well understood. The limit to the depth (d) is determined by the nature of the soil of which the bed and banks are composed, and the greatest velocity that the soil can bear safely.

The next step is to apply the formula to the design of new channels, to start them off as near as possible to a condition of silt-equilibrium. The discharge in such cases is known from the commanded area, and there is generally some choice as to the slope. A working diagram, drawn on the lines of the diagram given in the article, will then give the ratio of width to depth which is most suitable, and permit of the depth being calculated. Cases will occur, however, where the V_0 criterion is *not* obtainable, and in which the alternative is to make the ratio of width to depth as great as possible.

The article then continues to compare Mr. Woods' formula with Kennedy's, *in which the bed width has no place.* Mr. Woods' contention is that the width, as well as the depth, has an influence on *régime* mean velocity, and this view he discusses at some length before stating his new formula. But the slope has no place either in the V_0 formula, and therefore it might be concluded that, in Mr. Woods' opinion, this has also no influence on *régime* mean velocity. This conclusion is to some extent confirmed by Mr. Woods' formula for the slope which is a log. function of the discharge ($1/\log D^2$) which is itself a complicated log. function of the depth (or width). As stated above, the slope and the ratio (p) of width to depth are *inherent* in the V_0 formula and constitute by their relationship the chief characteristic of it.

Mr. Woods accordingly makes the critical velocity $-V_w = \log$ (w d) a function of both width and depth, that is of the area of the channel, and the degree of agreement with V_0 is shown on Diagram I of the article. Mr. Woods does not produce any data to explain why the curve of V_w should diverge from the curve of V_0 for depths above 7·0 feet and below 2·0 feet; nor is it explained how the slope calculated from the formula given above can produce *regime* mean velocity with the data afforded by Mr. Kennedy's observations. Finally, as Mr. Woods connects *w* and *d* by another formula, it follows that every width must have its own particular depth, or conversely, and that the ratio (p) of width to depth is fixed as soon as *w* or *d* is found or assumed, instead of being independent of both. Diagram II shows clearly how greatly this would restrict the use of the V_0 formula in the design of channels, confining them to *one line* (the curve shown) quite unnecessarily.

J. F., further, disagrees with Mr. Woods as regarding his views on the changes made in the multiplier of *d* in different parts of India or of the world, and holds that such action is not inconsistent nor objectionable in order to suit different grades or densities of silt. Mr. Kennedy marked on his Diagrams lines for 1·05 V_0 ($= \cdot 88d^{\cdot 64}$), 1·10 V_0 ($= \cdot 92d^{\cdot 64}$) to meet cases where the heavier grades of silt demanded a velocity greater than V_0; and on the other hand he allowed for a reduction in certain cases to 0·9 V_0 or 0·8 V_0, having in his mind channels at the tails of canal systems. There were no Sutlej Valley canals in those days, but the general principle would apply to them, taking out as they do from a river a long way down from the mountains and with a flatter gradient. Mr. Kennedy, in short, allowed for a latitude in the application of his formula; and tampering and toying only occur when the index of *d* is altered, which is quite another matter as it interferes with the general law.

To enter still deeper into this point, the Kennedy formula is a *particular case* of a general law which may be stated as $V = K\sqrt{r\,s}$. In the nineties of the last century, Kennedy, in common with all other canal engineers, worked on the basis of Kutter's formula, in which the coefficient K included *N*, *r* and *s*. In the case of stable channels *N* would have the same value, in fact Mr. Kennedy recommended $N = \cdot 02375$ for use in designing distributaries. *N* being constant, K depends on *r* and *s* only; but the range of *s* in this case is comparatively small and its effect on the numerical value of the coefficient was always doubtful, so with this eliminated K becomes a function of *r*, and the formula above for the general law assumes the exponential form—

$$V = K_1\, r^n\, s^{\cdot 5}$$

K, being a numerical factor only. It was probably on some such basis as this that Mr. Kennedy approached the problem, and the next step would be to replace *r* by *d*, the depth which is easily measured. Now

$$r = \frac{w\,d}{w + 2d} = \frac{p\,d^2}{(p+2)\,d}, \text{ or } \frac{r}{d} = \frac{p}{p+2} = m, \text{ say,}$$

p in the above is the ratio $\frac{w}{d}$, and *m* depends upon *the ratio of* width to depth in the channel. Substituting in the equation—$V = (K_1 m^n s^{\cdot 5})\, d^n$, for stable channels Mr. Kennedy found n = 0·64, and that the multiplier ($K_1 m^{\cdot 64} s^{\cdot 5}$) assumed the constant value 0·84 through adjustment of the three quantities to the particular conditions. Thus, $V = 0{\cdot}84\ d^{\cdot 64} = V_0$.

Now, Mr. Kennedy's observations were, with two exceptions, made on the Upper Bari Doab Canal, which, like the older Panjab canals, taps the parent river just as it leaves the mountainous country, where the gradient is steep and the silt heavy, and 0·84 may be considered to be a suitable multiplier for the Bari Doab and older canals. For the newer canals which take off far down the rivers where the gradient is less

steep and the silt of a finer grade, it appears reasonable to reduce the multiplier 0·84. Mr. Woods says that in the case of the Sutlej Valley canals, the formula $V_0 = \cdot 67d^{\cdot 64}$ has been accepted. How the figure 0·67 was arrived at is not known, but some reduction is not inconsistent. Nor is the reduction to 0·63 made by the Sind engineers for the purposes of the Sukkur canals necessarily inconsistent, though it is not known how this figure was arrived at either. But the Madras and Burma engineers have altered both the multiplier *and* the index, and this is not justifiable as the exponent of d is fixed by the general law of flow in these stable channels and this law cannot be affected by the quality of the silt.

PARTISANSHIP IN ENGINEERING.

A PARTISAN is an adherent of a cause or of a party, and when of a party he is actuated by what is known as party spirit." Partisans, when they are men of strong character and of ability, will render immense service to the cause they represent, and the greater the faults of their qualities, the greater their influence. In espousing a cause, they see only the one side of it; and fighting for that side, they are apt to lose the sense of impartiality and judgment. Yet they are often big men. William Ewart Gladstone was a big man, and Bright said of him: "Is it not wonderful how one-sided Mr. Gladstone can be, and how his great intellect can be subjected to one idea, and how he can banish from his mind everything, however important, which does not suit the purpose and object before him?" In saying that, Bright had no sort of personal animus, he and Gladstone were of the same party politics, and by reason of their common interests they had every reason to be friends. It was only that Bright, with his more sober common-sense, sometimes found Gladstone's partisanship repellent. Similarly, Hazlitt, one of the sanest of critics, said of Cobbett: "Mr. Cobbett is a very honest man with a total want of principle," and by that he meant that Cobbett was in such downright earnest in any cause he undertook that he lost his sense of all round judgment. In engineering affairs, the late Sir John Benton was something in the same way. He too was a big man, but once he had decided on the line he was going to take, he made himself oblivious to all other considerations. He no more stumbled at contradictions than did Dr. Johnson, another big man, and sometimes he disowned principles when principles were inconvenient.

The following is an instance. Of all Sir John Benton's projects, taking magnitude, daring engineering, and the fact that it was carried to completion in accordance with his intentions into consideration, his name will always be more closely associated with the Triple Canals of the Panjab than with any other scheme. It was not only a great project, it was more than that because it represented a significant advance in irrigation policy. In earlier days, the supplies of a river were tapped for the benefit of adjacent lands with little regard for the potentialities of all the waters of the rivers on a complete hydrographic survey. But the special feature of the Triple Canals project was that the surplus waters of the Jhelum were to be carried far beyond the confines of the adjacent tract, irrespective of what might be deemed to be natural geographical boundaries, to a distant doab, which otherwise could only have been irrigated from the Sutlej to the detriment of the country on the left bank of that river. It was the right thing to do, and Sir John Benton accepted the policy with enthusiasm. Later, when Oudh showed no desire for canal irrigation and the supplies of the Sarda river were going begging, he designed another daring scheme, the Sarda-Ganges-Jumna Feeder project, to convey water from the Sarda across the drainages of the United Provinces to the Ganges doab, and to the Jumna river and beyond it, for the benefit of the south-east Panjab. The principle in both cases was the same, the principle of carrying water from the immediate locality, where it was not wanted, far afield to lands where good use could be made of it. Yet, as Irrigation Adviser to the Bahawalpur Darbar in connexion with the Sutlej Valley project, and representing the interests of the Bahawalpur State, he opposed the participation of Bikanir in the scheme because the Bikanir State had no Sutlej riverain land and was not entitled to a share of the Sutlej water. It was a repudiation of the principles of the Triple Canals and the Sarda-Ganges-Jumna projects, the Lower Bari Doab had no riverain land on the Jhelum and the south-east Panjab had no riverain land on the Sarda, it was special pleading and in it Sir John showed that he was a partisan by temperament.

Advocates in courts of law have to plead the cause of their clients, it is their business; and politicians unless they have party spirit are apt to be regarded as of not much use to their party; but engineers can hardly be said to be in the same category, and no one was ever less of a partisan than the late Sir Thomas Higham who held so high a reputation for reliability of judgment in his day. He was reliable because, a cool, impartial, methodical business man, weighing every aspect of a question, he had nothing of the partisan spirit in him. As he said of himself, when sitting in contemplation of a complicated case, he would get up and walk to the other side of the table to see how it looked from an opposite point of view. He spoke metaphorically no doubt, and metaphorically he may have regarded his subject from all four sides of his office table, but it was because he brought his great intellect to bear dispassionately on any subject he had to deal with in all its bearings that his judgment was so greatly valued. Partisans have their uses, often great uses, but they have the defects of their genius, and in engineering the temperate, all round common-sense required of a judge would seem to be more to be prized.

Notes and Comments.

Indian Coal Supplies.—The colliery reports for the week ended 31st December 1927, show that many collieries are now accumulating stocks due to a plentiful supply of labour and consequent heavy raisings. Shipments from Kidderpore Docks continue to be very satisfactory, last month well over 200,000 tons of cargo coal left port.

Proposed Attempt on Mount Everest.—Provided permission is granted by the Government of Tibet, Captain Finch, member of the Everest party of 1922, is organising another British Everest expedition. At present Tibet is a closed country, and it is impossible to obtain the special concession which the expedition had enjoyed in 1922.

An Old Calcutta Tunnel.—An interesting discovery of an ancient tunnel has been made last week on the site of the old Sailors' Home in Strand Road where work by Martin and Co. is in progress in the erection of a new building for Messrs. Ralli Bros. Many surmises have been made as to the reason for its construction but up to the present, until further excavations have been made, nothing definite will be known.

The Darjeeling Himalayan Railway.—With regard to the question relative to the acquisition by the Government of India of this railway, Messrs. Gillanders, Arbuthnot and Co., the Managing Agents, state that they have nothing to add to their letter of the 5th November last. The lease will expire in the beginning of 1929, and if the Government wish to purchase the railway they will have to give one year's notice.

The Insein Government Technical Institute.—His Excellency Sir Charles Innes, Governor of Burma, attending the annual sports of this Institute, referring to the engineering profession said that it was pre-eminently one which should attract the young men of Burma and of India. No one, he remarked, who has served as long as I have in the Indian Empire, can fail to have the greater admiration for what the engineer has done for the country.

White Nile Bridge.—A British Official Wireless, dated Rugby, the 15th instant, states that another step in the development of the Sudan is marked by the announcement that the bridge over the White Nile, connecting Khartum and Omdurman, for foot passengers, vehicular traffic and electric trams, will be opened to-morrow. The bridge, which consists of seven spans each 244 feet long and an electrically operated swing span 304 feet long, lies across the White Nile at its junction with the Blue Nile. The roadway is 30 feet wide and provision has been made for two footpaths, each 11 feet wide, which can be carried on brackets when the volume of traffic justifies enlargement.

Railway Board's Statistics.—These for the week ended 24th December 1927, state that while increase is shown in the total approximate gross earnings of all State railways for this period on the figures of the last week, as well as on the figures of the corresponding week of the previous year, being Rs. 1 lakh and Rs. 13 lakhs, respectively, there is recorded a decrease in the number of vehicles loaded on the whole of the North Western Railway, both as compared with the last week and with the corresponding period last year. The daily average tonnage of all commodities received at Karachi during the week was 3,299 tons as compared with 3,828 tons during the previous week and 2,823 tons during the corresponding period last year. In connection with the Imperial Indian Mail, bookings for the next homeward season between 23rd February and 3rd May inclusive, shows that the train has already been fully booked up on seven occasions, on three of which the bookings are in excess of the normal composition of the train. On the remaining four occasions, which relate to dates on which the Aden Ferry runs from Bombay, the train has not yet been fully booked, but the bookings are sufficiently far advanced to make it probable that every train will be fully occupied.

Moghalpura Stores Embezzlement.—In the Moghalpura stores embezzlement case the three accused have been convicted by Mr. Phailbus, Magistrate of Lahore. Pritchard, Tirath Ram and Abdul Aziz have each been sentenced on the first count to six years' rigorous imprisonment and Rs. 3,000 fine. Pritchard was also sentenced on another count to two years' rigorous imprisonment and a fine of Rs. 200. Tirath Ram was accorded four years' rigorous and Rs. 1,000 fine and two years' rigorous and a fine of Rs. 1,000 on another count. All sentences to run concurrently. After six years in Lahore Jail it is hoped they will all try to qualify for membership in the Anti-Corruption League started by Bombay a year ago.

Pabna Water Works.—It is expected that this scheme, which was planned some time ago, will materialise shortly. The Government of Bengal have promised a donation of Rs. 80,000, provided a like sum is subscribed by the local public. Two zemindars of Tarash have promised Rs. 50,000 for the purpose, and have deposited the promised donation in the Tarash Bank in the name of the chairman of the Municipality. The District Board has been addressed by the Chairman of the Municipality for the payment of its promised donation of Rs. 25,000. The Municipality will for the present pay the balance amounting to Rs. 10,000, which it will later on realise from people who will take house connections as premiums.

Standard Oil Co. of New York.—We have received a letter from the General Manager for India of this Company, dated the 17th instant, which reads as follows :—"As there has recently been so much inaccurate and misleading information appearing in the press in reference to the importation of Russian petroleum into India by the Standard Oil Company of New York, the directors of this company have considered it advisable to issue a public statement of facts. A copy of this official statement is sent you herewith and we would be glad to have you give it publicity through your columns." We regret that the statement is much too long for insertion in our columns, at the same time we would state that the company have set up an able defence on their own behalf.

Eight-Cylinder Cars in Japan.—Although the sale of British cars in Japan has never been exceptionally large, there has been, for many years past, a steady demand for the high-grade British models. Six-cylinder cars with luxurious coachwork have always found favour with the wealthy Japanese, and latterly the eight-cylinder models have attracted attention. The Sunbeam Company were one of the earliest firms to develop the eight-cylinder car, and during the past few years have supplied their 30 h.-p. and 35 h.-p. models in considerable numbers. One of the principal residents of Tokyo is the owner of a 30 h.-p. eight-cylinder model, and this car is well known in that city, where its imposing appearance and unusual smoothness of running constantly evokes praise for the high-grade British car.

The Royal Microphone.—The Marconiphone Co., of London, have on several occasions been honoured with the task of amplifying His Majesty's voice at important functions, and it is interesting to know that a unique microphone is specially reserved for the purpose. This instrument is one of the well-known Marconi Magnetophones, which consist of a heavy cylindrical electro magnet between whose poles is placed a circular flat coil of aluminium wire mounted on cotton wool. When the coil moves under the influence of the sound waves the powerful magnetic field produces in it minute currents which are magnified very greatly by as many as eighteen or twenty super power valves, and the resultant output is reproduced by giant loud speakers having a normal range of over half a mile. The microphone itself is heavily silver-plated and bears a gold plate on which its record is engraved. It is covered by a special solid silver gauze cage, which carries the Royal Arms in gold, and acts as a protection against accidental disarrangement of the very sensitive coil. No one but His Majesty has used or will be allowed to use this microphone, which is undoubtedly the most valuable in existence and well deserves the title of "The Royal Microphone."

Sir Grimwood Mears and the Back Bay Enquiry.—On taking his seat in Court, Sir Grimwood Mears, the Chief Justice, received congratulatory addresses from members of the Bar on the occasion of his being made a K. C. I. E. Replying, he said the honour that had been conferred was a generous recognition of whatever may have been his services upon an inquiry which, though laborious, was in fact not a difficult one. "We were from the first greatly helped," he added, "by the care with which the Department of Industries and Labour at Simla had compiled the documents for our use, and later in Bombay that Government showed the utmost willingness to produce every document suggested by us, or which could in any way throw light upon the problems we had to solve. Similarly, in London the India Office were zealous in providing us with any information which any of us from time to time thought necessary. All this assistance greatly facilitated our work. There was another pleasant feature of the enquiry. From the very outset it was evident that there were circumstances apparent on the documents which it would be difficult, if not impossible, for anyone satisfactorily to explain. The candour and honesty which every witness at all affected by these matters showed in the box met the high appreciation of the Committee."

The Modern Cone Loud Speaker.—The Modern Cone Loud Speaker is very far ahead of its older brothers; as far, in fact, as the latter were in front of the early horn instruments, for each year sees new developments, new ideas resolved into practical form, old ideas re-modelled; and the research goes on unceasingly. The open cone of 120 to 135 degrees angle is universally popular, as it provides sufficient rigidity to ensure excellence of reproduction over a very wide band of audible frequencies, while at the same time lending itself to neat and artistic designs which will be in keeping with modern decorative requirements. One of the latest and most satisfactory reproducers of this type is the Marconiphone-Sterling Cone, which has a diaphragm approximately 8 inches in diameter suspended in a new and effective manner. The rim is moulded into a flat ring, which presses firmly on a felt seating secured to a circular disc of non-resonant material, all tendency to vibrate being thus completely damped out. It is interesting to note that the supporting disc is over one inch in thickness, giving exceptional solidity and entire freedom from the hollow, booming sound frequently introduced by lighter construction. Both sides of the cone are open, and a surprisingly rich, full volume of sound is obtained when the loud speaker is placed in a corner near the wall, as double the usual quantity of energy is transmitted to the air—a great point when dancing to wireless music.

New Albion Four-ton Rigid Six-wheeler.—During the past few months, the Albion Company, the well-known Scottish commercial vehicle manufacturers, have had many enquiries for a rigid six-wheel chassis, but while they readily admitted that they were working on a chassis of this description, the Albion Company preferred to defer production until their design had been thoroughly tested both at home and abroad. The thoroughness of their methods may be judged from the fact that one of these machines was actually sent out to India so as to be tested under the worst possible conditions, and the new model is based on the experience gained by this and other equally searching tests. The design embodies 30/45 h.-p. engine and a standard four-speed gearbox, on the rear end of which is coupled an auxiliary gearbox giving eight forward speeds in all. The rear axles are both of the overhead worm drive type, and are coupled by a short universally jointed shaft. The axles are supported on each side by inverted semi-elliptic springs, the centres of which are clamped to trunnions mounted on the ends of a dead axle. The machine complies with the British War Department specification for medium-weight six-wheel vehicles, but while this specification only asks for 9-inch lift of any wheel, the Albion six-wheeler exhibited at Olympia had two diagonally opposite wheels mounted on blocks no less than 15 inches high, thus demonstrating its ability to tackle extraordinarily uneven ground without frame distortion. This machine is designed to handle loads of 4 tons on the road or 3 tons across country, and there is little doubt that the Albion popularity in overseas countries will be still further enhanced by the introduction of this new model.

A Noteworthy Bridge Reconstruction.—A noteworthy bridge reconstruction feat has just been completed on the London and North-Eastern main line from King's Cross to the North. The old bridge over the Great North Road at Grantham was considered inadequate to support the increased weight of traffic, and it was decided to replace it by a single span steel bridge, composed of a heavy built-up trough girder and two parapet girders. The work entailed the supply of 90 tons of steelwork, 500 cubic yards of creosoted timber, and 260 cubic yards of rock asphalt. The bridge was constructed and erected by John Butler and Co., Ltd., of Leeds, to the design of Mr. C. J. Brown, the railway company's chief engineer, and under the supervision of Mr. A. J. Grinling, the railway company's district engineer at Peterborough. The order to proceed with the work was received on 20th October 1927. On 27th November, five weeks after the receipt of the order to proceed, the first half of the old bridge was removed and the first half of the new bridge erected in its place. The second half of the work was begun and completed on 4th December. During each of the two days' operations some 40 tons of old cast iron girders and a considerable amount of brickwork in jack arches had to be removed before the new girders could be fixed in position. The new steel work was lifted into position by means of a 35-ton and a 45-ton railway crane, obtained from Peterborough and Doncaster. Not only was the bridge manufactured and

erected within six weeks of the order being received, but on both erection days the line was opened for traffic before the time scheduled by the railway engineers. On the second day the bridge was open to traffic three hours ten minutes before the scheduled time, and the afternoon expresses in both directions were able to travel on the correct track on the up and down lines.

An Interesting Exhibit.—Among the many interesting exhibits at the recent Cycle and Motor Cycle Show at Olympia was the Stand of Hans Renold, Limited, the well-known manufacturers of Chain Transmission, occupying a Gallery site amongst the accessories. The attractive feature of the Stand and one which made every passer-by pause and look was an enlarged photograph of the winners of the Senior T. T. last year on Norton machines. Panels at each side of the photograph gave a significant list of the successes of machines fitted with Renold Chains in the T. T. in the Isle of Man, and in the most important international races. Once on the Stand, visitors were able to see typical Renold Drives for both cycles and motor cycles along with a complete range of spare parts showing the quality of manufacture, which is the tradition of the Renold House, and which is maintained in production to-day. Mounted on brackets were a series of wheels and chains and visitors could test for themselves the accuracy of the fit of the chain on the wheel teeth and the smooth and easy running of the chain. This firm are now marketing some new sizes of cycle chains ½ inch × 3/16 inch, ⅝ inch × 1/8 inch, and ⅝ inch × 3/16 inch, and in addition at the Show they introduced a series of Duplex Chains up to 1·0 inch pitch for motor cycle and automobile applications. A significant chart in one of the panels indicated the increase in sales of cycle chain since 1921. Another interesting feature of the Stand was the exhibition of an A. J. S. engine mounted on a stand demonstrating the overhead camshaft fitted with Renold Chain and the Weller Spring Adjustor, a flat spring in the nature of a jockey, which is claimed to be a most economical form of adjustment, adding considerably to the useful life of the chain and giving increased satisfaction to the user.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 5th January 1928:—Messrs. Callender's Cable and Construction Co., Ltd., Bombay—Pillars, distribution, for armoured cable ·04 square inch—one 10 ways, Rs. 1,031; two 12 ways, Rs. 2,516; one 6 ways, Rs. 986; seven 8 ways, Rs. 7,063 free delivery at railway station New Delhi by 12th May 1928; Messrs. Jessop and Co., Ltd., Calcutta—1 Motor, 24 b. h. p. at ½ hour rating, 570 r. p. m., 400 volts, 3-phase, with extra sliding base plate, Rs. 1,123 free delivery at railway station Sukkur by 8th March 1928; 647 cwts. 14 lb. Beams, R. S., British, of sizes, Rs. 6,067 free delivery Lucknow; Messrs. Worthington-Simpson, Ltd., Calcutta—2 Pumping Sets, centrifugal Crossley horizontal airless injection heavy oil engine, 21·5 b. h. p., 300 r. p. m., and Worthington 5-inch, 4-stage high lift centrifugal pump, capable of discharging 12,500 gallons per hour against a total head of 170 feet at 1,350 r. p. m., complete with tools and spares and circulating pipes, Rs. 15,069 free delivery at Chaklala railway station, engine *ex* stock works, England, and pumps 14 weeks from 9th January 1928; Messrs. Martin and Co., Calcutta—208 cwts. 104 lb. Beams, R. S., British or Tata, 10 inches by 5 inches, Rs. 1,580 free delivery Lucknow; points and crossings, complete, for 2-inch gauge 20 lb. rail tracks—6 sets left hand, Rs. 630; 16 sets right hand, Rs. 1,680; 5 complete pass-byes 20-lb. rails, Rs. 1,300; 40 switch boxes with levers and connecting rods, Rs. 840; 100 double side steel tip wagons, for 2 feet gauge 20-lb. track, complete and 10 spare axle boxes and rollers for above, Rs. 12,955 free delivery Panaghe, E. I. Railway; Messrs. Parry's Engineering Ltd., Calcutta—2 track miles 2 feet gauge light railway track, 20 lb. per yard, complete, Rs. 12,390 free delivery Panaghe, E. I. Railway; 20 platform wagons, steel, 2-ton, 24-inch gauge, complete, Rs. 1,960 free delivery Panaghe, E. I. Railway; Messrs. Turner, Hoare and Co., Ltd., Bombay—Parts, spare, for 10-ton Aveling and Porter compound steam road rollers, Rs. 1,229 free delivery at Harpalpur; 350 feet belting, of sizes, Rs. 1,096 free delivery at Sambhar.

Water Purification.—The following is a description of some of the latest activities of The Paterson Engineering Company Limited, the well-known water purification specialists, whose Indian headquarters are at 2, Dalhousie Square, Calcutta. The firm have supplied, or have on order, water purification plant for Gunong Pilai, Singapore, Hong Kong, Kobe, Tokyo and other important places in the Far East, on the coagulation and rapid filtration principle as supplied by them. Many Paterson contracts have recently been completed in South Africa; large plants have been installed at Durban, Cape Town, Johannesburgh and elsewhere. An interesting example of the latest practice in treatment of this character for a medium-sized installation, is a plant that has been officially opened at Pietermaritzburg, the City Engineer being Mr. J. J. Caskie, A. M. I. C. E. The installation has a capacity of 5,000,000 gallons of water per 24 hours. The raw water is first treated at the head works at Henley with lime and alumina coagulants, using automatic chemical proportioning gear, and then passed through hopper bottomed tanks in which the heavier suspended matter separates by gravity. Afterwards the water runs to the main purification plant by means of an aqueduct a mile long where a trace of lime is added to give a slight hardening so as to prevent any lead poisoning from the household supply pipes. When the coagulants and other chemicals have exerted their full action, the water is subsequently allowed to settle in four concrete tanks 132 feet 6 inches by 120 feet by 14 feet 9 inches having a total capacity of 1,500,000 gallons of water—7 hours' supply. From here, the water already nearly clear, passes to 8 Paterson rapid gravity sand filters constructed of ferro-concrete, each 24 feet by 14 feet 9 inches, filled with graded sand through which the water circulates at the rate of 80 gallons per square foot of filtering surface per hour, being collected at the bottom by 2,000 gunmetal nozzles in each unit. The clear water discharged by a channel is treated with a trace of chlorine gas by two Paterson "Chloronomes" on the way to the clear sterilised water storage tanks. The sand filters are cleaned in a few minutes every 24 hours by means of compressed air blown in at the bottom with momentary reversal of the crude water flow to sweep away the disentangled impurities, the same sand lasting for years. The whole design constitutes an extremely efficient arrangement, and it may be stated also that the Paterson Engineering Company have completed a plant near Lichfield in England for the South Staffordshire Waterworks in which the water from the filter beds is filtered and used again, giving a net consumption of only about 0·003 per cent. of the total volume—a remarkable advance in filtration technique.

Current News.

It is proposed to erect a linoleum factory at Auburn, near Sydney, Australia, at a cost of about £250,000.

It is proposed to put up a plant for the manufacture of aluminium at Bell Bay, Tasmania. The first unit is to cost £200,000.

The report of the directors of Roneo, Ltd., for the year ending 30th June last, shows that the profits of the concern amounted to £63,307-1-8.

Five large coal seams have been discovered to run right across the site selected for residential quarters of the Telfess mining region in Siberia.

Works have been acquired at Inchinan, near Renfrew, for the manufacture of the India pneumatic tyre. It is intended to produce 1,000 tons a day.

A new railway, which has been built between Levsky, in the district of Plevna and Lovech, was opened on 21st November last. King Boris drove the first train.

Valuable deposits of iron ore are said to have been discovered at Springfield, Antigonish County, Nova Scotia, where extensive drilling operations are being carried on.

It is stated that new plant for the concentration of North African phosphate is shortly to be erected by the Gafsa concern, which controls vast deposits of lower-grade material.

What is said to be one of the largest fireclay deposits on the British Columbia coast, situated near Hillbank, on the line of the Esquimalt and Nanaimo Railway, is being developed.

The exports of soda ash from the Magadi deposits of British East Africa increased to 25,547 tons for the first half of last year, as compared with 19,427 for the whole of the previous year.

Mr. J. T. Pringle, Assistant Agent of the Eastern Bengal Railway, has been appointed as Deputy Secretary of the Railway Board. The report that this post was being abolished was incorrect.

The total approximate gross earnings of State railways up to 31st December 1927 amounted to Rs. 74·75 crores, or Rs. 340 lakhs more than the figures for the corresponding period of the previous year.

The nitrogen fixation plant of Synthetic Ammonia and Nitrates, Ltd., at Billingham, is to be extended by the addition of two new units capable of producing 50,000 tons of nitrogen per year each.

The fourth unit, of 28,000 horse-power, at the Great Falls power plant of the Manitoba Power Company, is about to be put in operation, and preparations are being made for two more units of 40,000 horse-power each.

The experiments which have already been made by the Fuel Research Board on the production of liquid fuels from straw and waste vegetable materials have proved so successful that they are to be continued on a larger scale.

It is understood that tenders are to be asked in January by the Swedish-American Line for the construction of a third new motor liner. The new ship will have a length of 608 feet, a width of 78 feet, and a gross tonnage of 21,000.

One of the latest types of motor omnibuses put into service in Western America is capable of seating eighty-two passengers. It is driven by two six-cylinder engines, one for each driving wheel, so that no differential gear is necessary.

The total approximate gross earnings of State railways for the week ending 31st December 1927 amounted to Rs. 217 lakhs, which is Rs. 3 lakhs less than the figures for last week and Rs. 11 lakhs more than the figures for the corresponding week of the previous year.

According to a message from Haifa, Jerusalem, a start will be made on the new harbour works at Haifa on 1st May. It is stated that the Admiralty will contribute £500,000 towards the cost of the works subject to a special extension being provided suitable as a warship anchorage.

The Railway Board have sanctioned the construction, through the Eastern Bengal Railway, of a line of 5 feet 6-inch gauge, from Kalukhali to Bhateapara with a branch from Madhukhali to Kamarkhali, a distance of 53 miles. The project will be known as Kalukhali-Bhateapara Railway.

The Water Supply Committee of the Calcutta Corporation have framed rules regulating the sinking of tube-wells in Calcutta, especially the question of allowing comparatively shallow tube-wells temporarily until the Corporation can provide an adequate supply of filtered and unfiltered water.

The Finance Committee of the Burma Legislative Council have approved the proposal for the provision of Rs. 2,83,800 to be made in the Budget estimates for 1928-29 for the engagement of Messrs. Rendel, Palmer and Tritton, Consulting Engineers, London, to advise the Burma Government regarding the Yunzalin scheme for water supply.

Literary Notices.

"Iron and Coal Trades Review."—The well known official organ of the National Association of Colliery Managers has published a Diamond Jubilee issue, 1867-1927, a record of sixty years' progress in the Coal, Iron and Steel Industries, compiled by leading authorities and edited by Charles T. Shedden. This magnificent publication has been published (December 1927) by Industrial Newspapers Limited, 49, Wellington Street, Strand, London, W. C. 2. The issue, besides a very large number of authoritative technical articles, is further enriched by numerous illustrations, portraits and diagrams. It is a veritable compendium of information relative to the progress during the past sixty years of the great industries which the journal represents, and makes the widest possible appeal to the interest of those to whose support the journal is mainly indebted for the position it has attained. The Diamond Jubilee Number of the Journal forms a most attractive and informative addition to technical journalism. The price, 21*s*. net, is very moderate for this really valuable issue, and we feel confident that it will receive the worthy support of all connected with the industries named.

A Dictionary of Hindu Architecture.—Treating of Sanskrit Architectural terms, with illustrative quotations from Silpa-sâstras, general literature and archæological records. By Prasanna Kumar Acharya, I. E. S., M. A. (Calcutta), Ph. D. (Leiden), D. Lit. (London), University Professor of Sanskrit, Allahabad. Published by the Oxford University Press, London, New York, Bombay, Calcutta, Madras. 1927. Price, Rs. 20.

This dictionary owes its name to the University of London A glossary of the architectural terms used in the Mānasāra, the standard work on Hindu architecture, was prepared for the author's private use when he found it indispensable after struggling for two and a half years to edit for the first time and translate into English a text which is written in five different scripts, possesses eleven badly preserved manuscripts, has undergone five recensions and comprises more than 10,000 lines of a language rightly remarked by Dr. Bühler as the "most barbarous Sanskrit." In this connection there arose an occasion for the author to express to the University the opinion that an Encyclopædia of Hindu architecture was badly needed. Architectural expressions appear throughout the whole field of general Sanskrit literature and the epigraphical records, as well as in the extensive special branch of literature known as Vāstu-sāstras, more familiarly called Silpa-sāstras. Existing dictionaries, in Sanskrit, English, or any other language, do not elucidate architectural expressions: and the texts of the Vāstu-sāstras have been waiting for hundreds of years to be unearthed from manuscripts which are quite inaccessible without the guidance of a special dictionary that would also be instrumental in bringing to light many new things hitherto left unexplained in inscriptions and general literature. The University selected the author as the person most immediately concerned and entrusted him with the task suggesting that he should "make a full dictionary of all architectural terms used in the Manāsāras with explanations, in English and illustrative quotations from cognate literature where available for the purpose." Thus the terms included in this dictionary are primarily those found in the Manāsāra. But all the new architectural terms of any importance discovered in all the known architectural treatises, epigraphical documents, and general literature have also been added. To form even a faint idea of the Herculean labour involved in bringing out this colossal work a perusal of the preface is necessary. This the first volume published embraces 882 pages, one more volume "Indian Architecture according to Manāsāra Silpa-sāstra," has been published and two other volumes to complete the dictionary are in the Press. This dictionary is a veritable Encyclopædia of Hindu architecture. It deals with some 3,000 terms, relating to architecture, sculpture and cognate arts, and covers a vast number of topics. Under each term is brought together useful information in the form of a short article, illustrated, with quotations from Silpa sāstras, general literature and archæological records. It is a pioneer work. It is hoped that it may be instrumental in explaining many things hitherto left obscure in inscriptions and general literature. Two appendices enhance the utility of the work: in one appendix is given a sketch of the literature on the subject, while the other contains histories of ancient Indian architects, together with a short description of their works. Great has been the labour of the erudite author and he is to be congratulated on its successful issue, so also the publishers for the volume as regards its printing and general get-up is all that can be desired.

GOVERNMENT OF INDIA
RAILWAY DEPARTMENT
(Railway Board)
NOTICE.

Steel Sleepers and Keys for Broad Gauge Indian Railways.

TENDERS are invited for the supply to **Broad Gauge Indian Railways** during 1928-29 of steel sleepers and keys described below :—

1 Description of sleepers.	2 Description of keys.	3 Quantity required in 1928-29.	
		Tons.	Nos.
Steel, for Broad Gauge 90 R.F.F. rails, 5′ – 6″ gauge, weighing 168 lbs. each.		17,000	226,667
	Steel, for use with sleepers described in column 1.	824	997,350

2. The Railway Board will also consider tenders for equivalent quantities of sleepers and fastenings for use with 90 R. F. F. rails, 5′ – 6″ gauge, to designs alternative to those specified in clause 7 of this notice.
3. The monthly deliveries offered must be stated on the tender form.
4. Simultaneous tenders for the above quantity are also being called for in England through the Director-General, Indian Stores Department, London.
5. Tenderers may quote for the sleepers with keys, or for sleepers or keys only, or for the whole or part of the total quantities required.
6. The quality of material and standard of workmanship must conform to the specifications in every respect.
7. Copies of tender forms, "General conditions of Contract," specifications and drawings can be obtained on application to the Secretary, Railway Board, New Delhi, on an inclusive payment of Rs. **2** per set. If the money is sent by Money Order a reference to this advertisement should be made. This fee will not be refunded.
8. Firms that are not on the approved list for the supply of steel sleepers and keys should support their tenders with certificates from the Indian Stores Department to the effect that they possess workshops and appliances for turning out work of the desired standard and within the period quoted in the tender.
9. No covering letters should be sent.
10. After tenders have been submitted, no representatives of the tendering firms will be granted interviews in connection with these tenders.
11. Tenders must be enclosed in sealed covers superscribed **"Tender for steel sleepers"** and should reach the Secretary, Railway Board, before 4 P. M. on the 28th February 1928, at which time they will be opened by the Secretary, Railway Board, or an officer acting on his behalf, in the presence of any tenderers who may desire to be present, and the quotations will be read out.
12. The tender prices will be for the designs as shown on the drawings, but if any alterations in the designs are found necessary at the time of placing the order or during the execution of the work, the consequent variation in the tender prices will be settled by negotiation.
13. The Railway Board reserves to itself the right to eject any tender without assigning a reason and does not bind itself to accept the lowest tender or the whole or part of any tender.
14. No earnest money or security is to be sent with tenders.

J. KAUL,
Secretary Railway Board.

NEW DELHI
The *5th January 1928.*

NOTICE.

Dacca University, New Muslim Hall.

SEALED TENDERS under lump sum contract are invited for the construction of a New Muslim Hall for the University of Dacca comprising :—

I. **An Assembly Hall,**
Hostels,
Prayer Hall,
Dining Hall,
Superintendents' Quarters,
II. **Servants' Quarters,**
III. **Servants' Latrines,**

at an estimated cost of approximately Rs. **7,20,000.** The Bill of Quantities and Specification can be obtained from the Registrar of the University at Ramna, Dacca, on payment of Rs. **5.** The Bill of Quantities is supplied as a rough guide to tenderers. It is believed to be accurate but the University takes no responsibility for its accuracy. Tenderers must therefore check these quantities or prepare their own bills of quantities to ensure that there are no omissions as such will not be paid for separately.

The Plans can be seen at Room No. 2 on the first floor of Writers' Buildings, Calcutta, or the office of Mr. D. J. Blomfield, Executive Engineer, Dacca, from whom any further particulars required should be obtained.

The tenders should be in a lump sum for the completed work and should be accompanied by a schedule of rates. Any additions or alterations ordered in writing by the Engineer in Charge will be paid for at these schedule rates.

The contractor will be permitted to manufacture bricks from the Government Brick-field at Pargandaria situated on the other side of the River from Dacca and a royalty of Rupee one per thousand bricks loaded into the Kiln will be payable by the contractor. This brick-field is said to be capable of producing from 40 to 50 lakhs of bricks only. The balance will have to be arranged for by the contractor.

The following quantities of materials belonging to the University will have to be taken over by the contractor at the site of work :—

1st class bricks ... 27,000 Nos.
@ Rs. **29-8** per 1,000.

2nd class bricks ... 42,000 Nos.
@ Rs. **28-8** per 1,000.

1st class bats ... 24,000 cft.
@ Rs. **22-8** per 100 cft.

Jhama bats ... 16,600 cft.
@ Rs. **21-8** per 100 cft.

These rates should not be taken as the current market rates for bricks.

The tenders will be accepted by the Executive Council of the University on the recommendation of the Engineer in Charge of the work, and will be received by the Registrar of the University up to noon on the 15th February 1928 and opened by the Vice-Chancellor in the presence of the Engineer in Charge, and any tenderers who may wish to be present.

The tenders must be accompanied by Rupees ten thousand as earnest money in G. C. or G. P. notes.

The tenderers should state in what period they will complete the work.

The Executive Council does not bind itself to accept the lowest or any of the tenders.

N. AHMAD,
REGISTRAR,
University of Dacca.

Foreign Notes.

Timiskaming and Northern Ontario Railway.—The progress made in the development of the mineral and timber resources of Northern Ontario, Canada, is indicated by the fact that last year, for the first time, the Timiskaming and Northern Ontario Railway has been able to meet its full interest charges without any help from the Government. The railway is the property of the Government of Ontario, which, this year, received from the undertaking an operating surplus of £260,000. When the railway was first built it passed through a region of virgin forests.

Russian Imports of Tractors.—We learn from the first issue of the new journal "Bank for Russian Trade Review" that until three years ago the tractor was a novelty in the Soviet Union; at the present time, however, some 30,000 are in use, most of which are of American manufacture. A considerable number of United States firms participated in the International tractor tests, which were held under official supervision in the northern Caucasus during August and September last. German, Swedish, Czecho-Slovakian and Austrian machines were also tested. As a result of these trials, standard tractors and implements, such as ploughs, harrows and threshers, will be selected for import into the Soviet Union.

Proposed Manufacture of Paper in South Africa.—According to the "South African Mining and Engineering Journal," among the latest ventures to be talked of locally is a proposal to manufacture paper from the extremely tough and fibrous grass which grows in such profusion in the Transkei districts. Laboratory experiments have proved most encouraging, and steps are now being taken to establish the undertaking on a commercial basis. It is not, of course, the first time that a papermaking industry has been started in South Africa, but previous efforts have been more particularly directed to the manufacture of brown wrapping paper, and although a first-class material was produced, it unfortunately failed to achieve the commercial success that the enterprise and patient persistence shown by its promoters in face of numerous difficulties deserved.

Central African Railways.—The Lake Victoria Branch of the Tanganyika Central line from Tabora to Mwanza is now open as far as Shinyanga, and it is reported that the first train should run into Mwanza early this year. This will establish communication for Lake Victoria with both Mombasa and Dar-es-Salaam. Next year should see the linking up of the Kenya-Uganda Railway with the Busoga Railway in Uganda, as well as a considerable advance in the extension towards the Nile, north of Lake Albert and to Kampala, the commercial capital of Uganda, while the extension of the Tanga Railway from Moshi to Arusha should have been completed during 1927. In 1928, also, work should be begun on the Zambesi Bridge. The generous offer of the Beit Trustees to provide the money for the construction of a combined road and rail bridge over the Limpopo at Liebig's Drift as a memorial to the late Mr. Alfred Beit has been accepted, so that both this project and the extension of the South African Railways branch line from Messina to a new point about a mile north of the river in Southern Rhodesian territory have received the necessary sanction.

Hydro-Electric Power Storage in Germany.—What are claimed to be the world's largest centrifugal pumps have been ordered for the hydro-electric storage system of the Rhenish-Westphalian electricity works, to lift water from the River Ruhr into a large storage reservoir. This system has been adopted in many instances on the Continent of Europe in connection with hydro-electric plant. A number of generating stations are linked together, and at certain seasons of the year, when there is an excess of water power available, the excess power is utilised to raise water to a high-level reservoir, where it is stored until required for dealing with peak loads. The three pumps will be of 34,000 h.-p. each, and were supplied by Sulzer Brothers. They will be driven by water turbines, the normal working conditions of the pumps when absorbing the maximum power being 180,000 gallons per minute against a head of 490 feet. The pumps will be able to deliver a somewhat smaller quantity of water against a maximum head of 550 feet. The two conditions represent working with an empty or full reservoir respectively.

"La Playa."—During 1923 the "La Playa," the first large Diesel-electric vessel to be built in this country, ran her trials, says the "Electrical Review;" it was decided subsequently that her engines should be replaced by those of another design, and it was found that Fiat two-cycle engines were of suitable dimensions for the space at the disposal of the builders. The new installation has recently been completed in Italy; her owner is the United Fruit Co., Boston. The original machinery arrangements have been adhered to, inasmuch as there are four engines coupled to main and auxiliary generators, the auxiliary machines being used as exciters for the main dynamos and for the propelling motor aft. There are two armatures in series on a single propeller shaft. The four main generators are in series, so that multiples of 220 volts up to 880 volts are obtained. The machinery is of the latest specially balanced type, each engine having four main working cylinders with a bore and stroke of 500 mm.; the designed speed is 250 r. p. m. and the normal output of each unit 950 b. h. p., so that the aggregate power of the Diesel engines is 3,800 b. h. p.

The Isle Maligne Transmission Line, Canada.—The high-power transmission line, linking up the City of Quebec with the hydro-electric station of Messrs. the Duke-Price Power Company, at Isle Maligne, on the Saguenay River, a tributary of the St. Lawrence, was completed recently, and was officially opened on 12th October last. The line, which is the property of the Shawinigan Water and Power Company, Limited, and cost over 5 million dollars to construct, is 136 miles in length, and is capable of delivering 100,000 h.-p. at 165,000 volts. The power is transmitted on two circuits, the wires being carried on steel towers, 85 feet in height. By means of this line it is now possible to interconnect the entire Quebec system of the Shawinigan Company and its subsidiary concerns, so that the current developed on the Saguenay River can be brought, not only into the City of Quebec, but, if necessary, into Montreal. The harnessing of the falls at the outlet of Lac St. Jean will undoubtedly play an important part in the development of industrial Quebec. At present the chief consumers of power from this source are the Anglo-Canadian Pulp and Paper Mills, Limited, Limoilou, and the Ste. Anne Paper Company, Beaupré.

Harbour Extensions and Bridge over the Swan River.—Harbour extensions and a new bridge over the Swan River at Fremantle, the port of Perth, W. A., and subsidiary works, at an estimated cost of £3,200,000, have, says the "Industrial Australian," been recommended to the State Government by the Engineer-in-Chief, Mr. F. W. H. Stileman. He suggests the construction of a bridge for road and rail traffic at a point 1,000 feet above the existing bridge over the Swan River at Fremantle, up to which the harbour works would be extended. He recommends also for construction at a later period, extensions to the north of the present harbour entrance, instead of above the proposed new bridge, as recommended by Sir George Buchanan. The bridge and approaches, including a railway from North Fremantle to Robb's Jetty, are estimated to cost £1,200,000. The extension of the harbour up to the new bridge, providing 5,750 feet of additional quay, with equipment, making a total of 15,829 feet, and dredging to a depth of 32 feet below low water, are estimated to cost £2,000,000. The present width of the harbour is 1,400 feet, with a depth of 36 feet below water level. Over the extension a depth of 32 feet is intended and a gradual reduction of the width to 800 feet at the upper end.

Steam *versus* Electric Traction.—The recent announcement that the Austrian Federal State Railways had decided to abandon the proposal to electrify the main line from Vienna to Salzburg has now been supplemented by some interesting facts concerning the relative cost of electric and steam operation in that country, says the "Engineer." A detailed calculation has apparently shown that electric haulage on the Vienna-Salzburg line would cost 9,000,000 Austrian shillings, or £260,000, more per year than steam traction. In 1920 leading Austrian economists and industrialists came to the conclusion that electric operation would result in cheaper transport, but since that time the price of coal has been reduced. In 1922 coal suitable for railway purposes cost 80 Austrian shillings, or £2 6*s*., per ton. To-day, however, the same coal can be purchased for about 30 Austrian shillings, or 19 English shillings, and this reduction in cost, coupled with the fact that the fuel consumption of the steam locomotives has been improved, has placed electric traction in a rather unfavourable position. The coal bill of the Austrian railways was twice as high in 1923 as it has been during the present year, and at the same time the cost of hydro-electric power has increased. In 1920 and in the following year Austrian currency was steadily falling, and during this inflation period it was possible to erect power stations at comparatively small cost, but credit conditions at present make the erection of such stations expensive, and, all things considered, railway electrification, it is held, does not pay.

Recuperators for Soaking-Pits.—With a view to effecting fuel economy, the Donner Steel Company, Buffalo, U. S. A., has been experimenting with a trial pit, with a width of 5 feet 6 inches by 9 feet 6 inches, holding six ingots 21½-inch square, each weighing approximately 7,800 lb. In the conventional style of pit having regenerative chequer chambers, the exhaust port and firing port are on opposite ends of the pit, but the recuperative pit has the firing and exhaust ports located in the same end wall. Since the firing port is above the top of the ingots, the gases are said to be prevented from coming in contact with the steel until they are well mixed and burned. The decreased fuel consumption obtained with the recuperative-type pit is in part due to decreased radiation. The single recuperative pit has but one wall radiating heat to the outside, namely, the plug wall end of the recuperator with its observation holes. Sidewalls are lined with tiles through which air passes, and these tiles and the air serve to prevent the loss of heat in that direction. The end opposite the plug wall is separated from the outside air by the slag pocket. Another reason given for fuel economy, says "The Iron Age," is that the uniform heating saves the fuel formerly wasted when the operator found it necessary to reduce the pit temperature with excess gas while the heat equalised itself throughout unevenly-heated ingots. Since the flame travels the length of the pit twice, it is in the recuperative pit, it is emphasised, more than double the time that it would be in the regenerative pit. This liberates more heat in the pit proper. It also eliminates high flame temperature so often found in the chequers. The stack temperature of the gases leaving the recuperative pit with coke-oven gas averages below 800° F.

Short-Wave Tests.—In its pursuit of knowledge of short waves, the General Electric Co. of America has developed a five-metre transmitter wherewith propagation tests will be conducted. Apparently the signal follows a straight unobstructed line: a receiver on a hill will pick up a strong signal, but the same receiver, when placed on the other side of the hill, so that it is not within the "line of vision" from the transmitter, will get a barely audible signal. Natural static was absent from the tests made, but man-made static, such as that from the ignition systems of automobiles, was very noticeable; thus far the transmitter has been tested only thirty miles away. Extremely high frequencies are involved, a five-metre wave representing approximately 60,000,000 cycles per second, and the 1-kilowatt transmitter is constructed so that it can be elevated and swung from one of the 300-foot masts at the transmitter laboratory at South Schenectady. Two new type, four-element, air-cooled valves are used in the special oscillator circuit; the antenna is about 8 feet long, and consists of a half-wave radiator, voltage fed, connected directly to the oscillator. A meter in the middle of the antenna is used for measuring the antenna current, which is read by means of a surveyor's transit on the ground. Tuning the transmitter is made possible by a rope drive connected with a "vernier" control; wires for supplying power and control are run to the transmitter from the ground. The portable five-metre receiver used consists of a regenerative detector and one audio amplifier; the grid tuning coil consists of five turns of wire 0·5 inch in diameter; the "tickler" coil is 0·25 inch long and 0·25 inch in diameter, and it is inside of the grid coil. Very small condensers located close together are used for tuning and regeneration control, and special low-capacity valves are used. Generally, it is unnecessary to use any antenna, the 'phone cords picking up sufficient energy; an antenna may, however, be used.

General Articles.

KENNEDY'S V_0 FORMULA.

It is over thirty years since Kennedy published his formula and it is surprising to learn that there is doubt about the method of applying it to the design of irrigation channels. But Mr. Woods, in an article which appeared in "The Engineer," mentions that perplexity is still felt in the design of "*régime* channels" and himself propounds a *New Hydraulic Formula* for the "critical" velocity. In these circumstances it will not be out of place to review the V_0 formula and while elucidating the general principles to show also the conditions that limit its application in practice. Mr. Woods' formula received editorial notice in the issue of INDIAN ENGINEERING of 24th September and will be compared with the formula it is intended to supplant in the course of the general survey that follows.

The formula for V_0 is based on 20 observations,—10 on canal reaches and 10 on distributaries of the Bari Doab Canal system. Seven observations were rejected by Kennedy,—5 on canal reaches of the B. D. C. system and 2 on the Katora inundation canal,—on the ground that these channels had not attained the stage of silt equilibrium. The depths and velocities of all these channels are shown on Diagram I together with the curve of V_0. Mr. Woods' curve of V_w for the "critical" velocity is also given, and a curve based on Barnes' formula which, in the writer's opinion, may be held to give the "critical" velocity quite approximately.

The equation $V_0 = {\cdot}84d^{\cdot 64}$ is, and must be, a *particular* case of the general law that governs the velocity of flow in channels, and must be derived from the law as expressed in the exponential form. As given by Barnes the law is—$V = 60r^{\cdot 7}\sqrt{s}$; while Manning gives it as—$V = \frac{1{\cdot}486}{N} r^{\frac{2}{3}} \sqrt{s}$ in which Kutter's N is retained so as to make the equation generally applicable to all classes. This equation becomes $V = 62{\cdot}4r^{\frac{2}{3}} \sqrt{s}$ when $N = \frac{1}{42} = {\cdot}0238$ which it is practically for channels that have reached a state of silt-stability. By making a suitable change in the numerical factor 0·84 in the formula for V_0 both of these equations by Barnes and Manning could be made to give the "critical" velocity approximately with indices of 0·7 and 0·666 respectively for *d*. Kennedy's index of *d* (which is derived of course from *r*) is 0·64, and it is found that the equation $V = 64{\cdot}4r^{\cdot 64}\sqrt{s}$,—which is derived from an examination of Kutter's formula to be given further on,—represents quite approximately the general law from which the particular equation for V_0 was derived.

Thus, if *m* be put for the ratio $\frac{r}{d}$ making $r = md$, and V and V_0 be equated, $V = 64{\cdot}4m^{\cdot 64}d^{\cdot 64}\sqrt{s} = V_0 = {\cdot}84d^{\cdot 64}$, or $64{\cdot}4m^{\cdot 64}\sqrt{s} = 0{\cdot}84$, showing how *m* and *s* are merged in the constant ·84 *in channels that have reached the condition of silt-stability.* This can be exhibited more clearly by putting *p* for the ratio $\frac{w}{d}$ making $w = pd$, *w* being the mean width of channel where there are side-slopes; then as $r = \frac{wd}{w + 2d}$, $\frac{r}{d} = m = \frac{w}{w + 2d} = \frac{p}{p + 2}$ is the equation connecting m and p. Substituting in the relation above,—

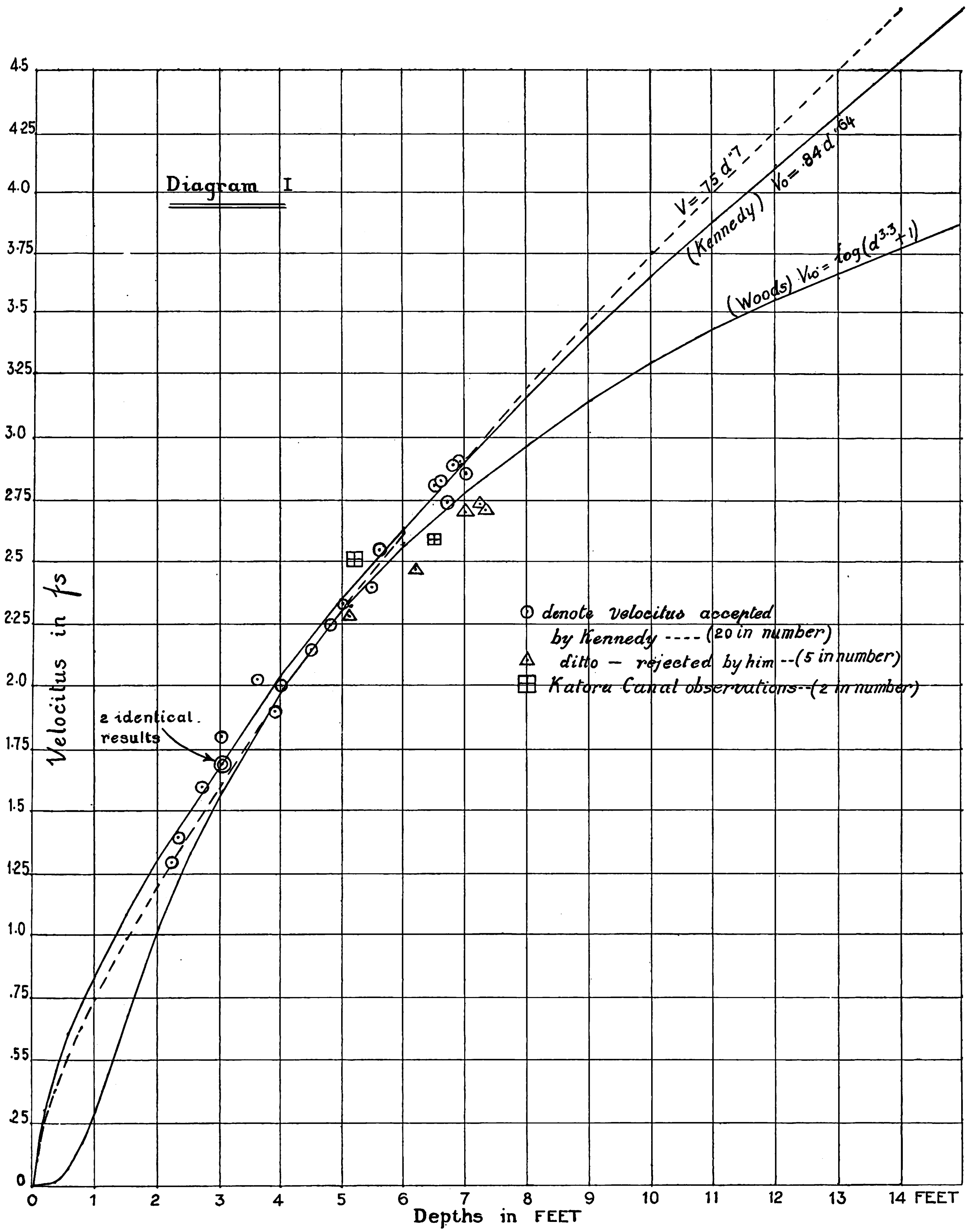
$$64{\cdot}4 \left(\frac{p}{p + 2}\right)^{\cdot 64} \sqrt{s} = 0{\cdot}84 = \text{constant.}$$

Thus in these self-adjusted channels each *p*, or ratio of width to depth, has its particular slope *s*, *and this is the essential principle of Kennedy's formula.* For an assumed value of *p* (say 5 for example) there may be any number of widths and depths (such as 25 and 5, or 20 and 4, or 15 and 3, etc.), but all the channels of these dimensions *must have the same slope* for silt-stability. The discharge (Q) will of course be different in each case, and so will V_0 which is equal to $\cdot 84d^{\cdot 64}$ in each case.

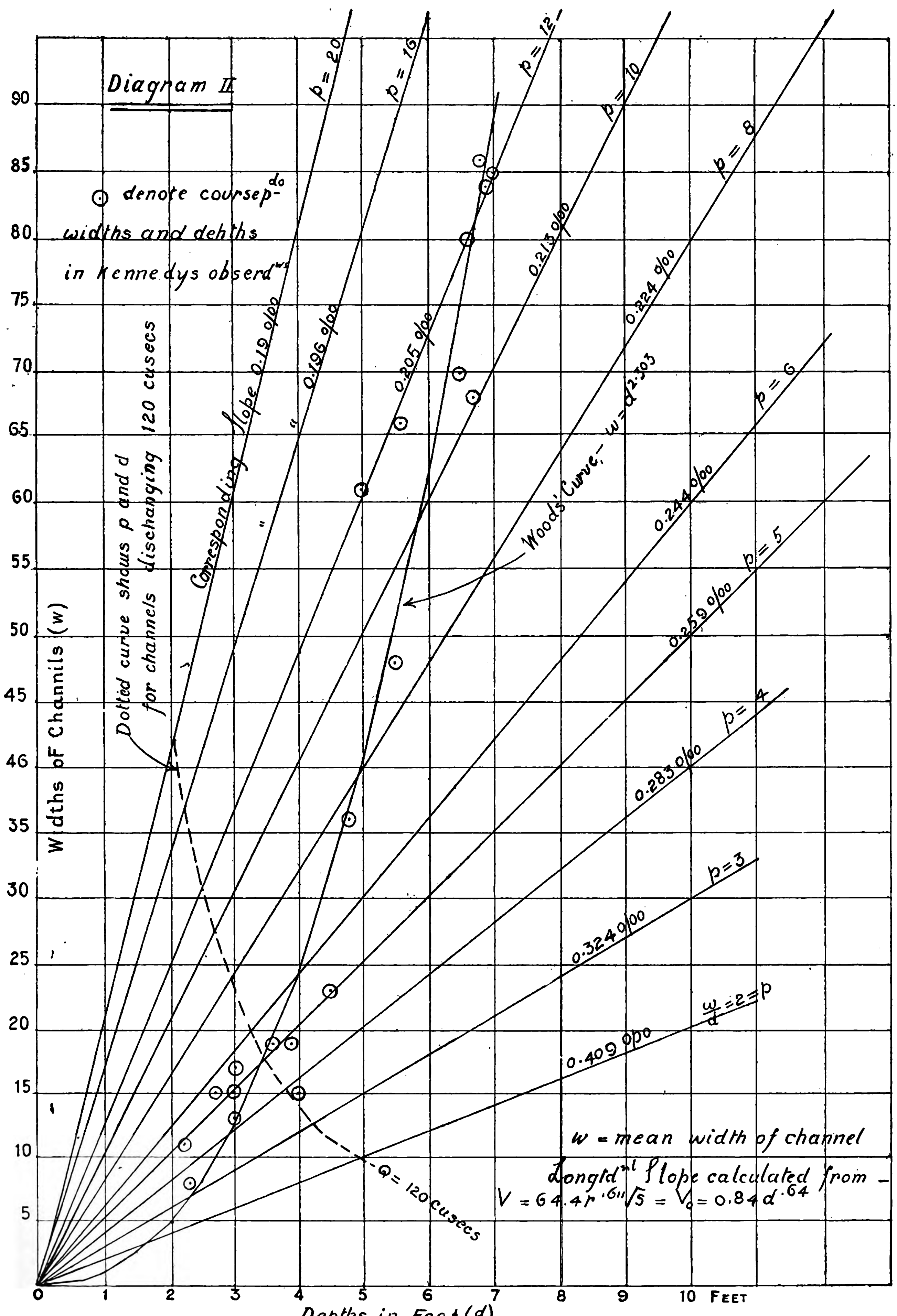
The sub-joined Table has been calculated from the equation above after changing it into the form—$\left(\frac{1}{s}\right)^{\frac{1}{2}} = 77m^{\cdot 64}$. A similar statement calculated for the equation $V_B = {\cdot}75d^{\cdot 7}$ gave slopes that did not differ much from those in the Table. It will be seen that the steepest slope required for silt-stability is 1 in 2441, when p = 2. In good design this is the lowest value for p, and then $m = \frac{1}{2}$, *i. e.*, $r = \frac{d}{2}$. The flattest slope permissible,—when m = 1·0, and p is very large,—is $\left(\frac{1}{s}\right) = 77^2 = 5929$ or ·169 ‰. Barnes' formula makes the flattest slope 1 in 6400, so that the limiting slope may be assumed to be about 1 in 6250 or ·16 o/oo. The figures in this Table refer to V_0, but if owing to a change in the grade or density of the silt it be possible to use, say, $0{\cdot}8V_0$ in place of V_0, then flatter slopes will ensure silt-stability.

$p = \frac{w}{d}$	2	3	4	5	6	8	10	12	16	20	30	40
$m = \frac{r}{d}$	·5	·6	·66	·714	·75	·8	·833	·857	·888	·909	·937	·952
$m^{\cdot 64}$	·642	·721	·771	·806	·832	·867	·89	·906	·927	·941	·959	·969
$\left(\frac{1}{s}\right)^{\frac{1}{2}} = 77\,m^{\cdot 64}$	49·4	53·5	59·4	62·1	64·0	66·7	68·5	69·8	71·4	72·4	73·9	74·6
$\left(\frac{1}{s}\right)$	2441	3083	3528	3854	4103	4456	4696	4867	5099	5248	5459	5570
Slope o/oo	·409	·324	·283	·259	·244	·224	·213	·205	·196	·190	·183	·179
Depths as observed range up to ...	......	2·2	4·0	4·5	......	5·5	6·7	7·0	......	... ..	...	......

Diagram II illustrates the Table, and shows,—by circle enclosing dot,—the *w* and *d* of each of the 20 channels accepted by Kennedy as fulfilling practically the condition of silt-stability. The other seven channels are *not* marked on this diagram as it cannot be assumed that they have the slope appropriate to the line of p on which they would be situated. For instance, a number of the distributaries lie on, or about, the p = 5 line, and, it may be assumed, have a slope of about ·259 o/oo. Similarly, six of the canal



KENNEDY'S V_0 FORMULA.



KENNEDY'S V_0 FORMULA.

observations lie on or about the $p = 12$ line indicating a slope of about ·205 ‰, but this assumption as to the slope could not be made in the case of the rejected channels in which the velocity does not conform with V_0. In short, any point on this diagram (obtained by the intersection of w and d) marks the dimensions of a channel with silt-stability *provided* it has or may be given the slope appropriate to $\frac{w}{d}$. According to Mr. Woods, whose curve is also marked on the diagram, the dimensions of silt-stable channels can only be obtained from points situated on his curve, an unnecessary restriction which will be referred to again further on.

A dotted line on Diagram II shows the widths and depths of channels that will discharge $Q = 120$ cusecs,—not that *all* widths and their corresponding depths are suitable in practice; the line is given for purposes of illustration and to emphasise the condition that for any values of w and d that may be taken the slope must be that appropriate to $\frac{w}{d}$ or p. Thus, a channel with $w = 20$ and $d = 3{\cdot}3$ will discharge 120 cusecs if the slope is ·244 ‰ or that due to $p = \frac{w}{d} = 6$. In practice Q is determined by the commanded area while the longitudinal section gives a limited choice of slope. Reference to Diagram II will show the appropriate value of p and then the depth can be calculated as follows,—$A = wd = pd^2$; $V = V_0 = {\cdot}84d^{\cdot 64}$, whence $Q = AV = {\cdot}84p\ d^{2 \cdot 64}$. The line for $Q = 120$ shown on the diagram was obtained in this manner, and obviously a series of such lines could be drawn on it. As the limiting value of d is about 10 feet, for which $V_0 = 3{\cdot}67$ fs, (about as high a velocity as good material will stand), the limit of Q for $p = 25$ is 9167 cusecs. Where $V = {\cdot}8V_0$, the limiting depth is raised to about 14 ft. and the limit of Q to about 18,000 cusecs. The short statement given below shows how the widths may be graduated with increasing discharge, and a statement on these lines with closer graduation of d and p would be useful for trial calculations.

Depth d	Values of $p = \frac{w}{d}$ and slope ‰ for each											
	2	3	4	5	6	8	10	12	16	20	30	40
	·409	·324	·283	·259	·244	·224	·213	·205	·196	·190	·183	·179
	Values of discharge Q for depths given in Col. 1											
1	1·7	2·5	3·4	4·2								
1·5	4·9	7·3	9·8	12·2								
2	10·5	15·7	21	26	31							
2·5	.	28	38	47	57	75						
3	......	......	61	76	92	122	153					
4	....	.....	......	163	196	261	326					
5	......	......	......	294	353	470	588	705	941			
6		......	...	......	......	762	952	1142	1523	1899		
7	.....	......	......	......	......	1144	1430	1716	2288	2860	4290	
8	.....	......	......		...	... ..	2034	2441	3255	4069	6103	
9	......	......	...	......	......	.. ...	2776	3331	4442	5553	8329	
10	......	.....	......	... -	.....	......	..	4399	5867	7334	11000	14666

To show now why the equation $V = 64{\cdot}4r^{\cdot 64}\sqrt{s}$ was employed to represent the general law in this case. The formula for Kutter's coefficient may be written

$$C = \frac{N\left(41{\cdot}6 + \frac{{\cdot}00281}{s}\right) + 1{\cdot}811}{N\left(41{\cdot}6 + \frac{{\cdot}00281}{s}\right) + \sqrt{r}} \times \frac{\sqrt{r}}{N},$$

and when $r = 3{\cdot}28$ feet, or one metre, and $\sqrt{r} = 1{\cdot}811$ this becomes $C = \frac{\sqrt{r}}{N} = \frac{1{\cdot}811}{N}$, in which C is independent of the slope s,—a property or peculiarity of the formula, and an example of a particular case of a general law. $N = {\cdot}0238 = \frac{1}{42}$ in all these channels very approximately: and substituting this value and the value 1/5000 for s, in the general expression above we get $C = \frac{3{\cdot}14\sqrt{r}}{1{\cdot}33 + \sqrt{r}} \times \frac{1}{N}$. This is very similar to Bazin's later formula, and for $N = {\cdot}020$ becomes $\frac{157}{1 + \frac{1{\cdot}33}{\sqrt{r}}}$. Manning converted it to—$C = \frac{1{\cdot}4858\ r^{\frac{1}{6}}}{N}$ which $= \frac{1{\cdot}811}{N}$ as before when $r = 3{\cdot}28$ feet, the value for $N = \frac{1}{42}$ being $C = 62{\cdot}4r^{\frac{1}{6}}$. With Barnes' index it becomes $C = 60\ r^{\frac{1}{5}}$, and with Kennedy's index of 0·14, (nearly $\frac{1}{7}$), $C = 64{\cdot}4r^{\cdot 14}$, making the general formula for the velocity—$C = 64{\cdot}4r^{\cdot 64}\sqrt{s}$ as employed above. Barnes' formula with index 0·7 for r more nearly represents the general law as shown by the short Table below.

r	Kutter's C (N = ·0238)	$\frac{C}{r^{\cdot 14}}$ (Kennedy)	$\frac{C}{r^{\frac{1}{6}}}$ (Manning)	$\frac{C}{r^{\frac{1}{5}}}$ (Barnes)	—
2	69·4	63·0	61·8	60·4	The variation in Barnes' coefficient is much smaller than in either of the other two.
3	74·6	63·9	62·1	59·7	
4	79·6	65·6	63·2	60·3	
5	82·6	65·9	63·2	59·9	
6	85·6	66·6	63·5	59·8	
7	88·1	67·1	63·7	59·7	
8	90·6	67·9	64·0	59·8	
9	91·6	67·3	63·5	59·0	
10	95·8	69·4	65·2	60·4	

The equation $V_b = \cdot 75d^{\cdot 7}$, derived from Barnes' formula, is compared with Kennedy's V_o and Mr. Woods' V_w on Diagram I, and as already mentioned in the writer's opinion represents the critical velocity equally as well as V_o.

This preface makes it easier to compare Mr. Woods' new formula with Kennedy's. Mr. Woods insists that the width as well as the depth has an influence "on *regime* mean velocity" and this may be admitted to be correct, but he means by this that the formula for V_o should contain a *visible* factor for *w* as well as for *d.* From the *averages* of the canal channels and the distributary channels he finds the ratio $\frac{d^{\cdot 64}}{\sqrt{r}}$ to be constant and "that this constancy does not hold good when *d* is raised to a power of index other than 0·64. It is this that forms the chief characteristic of Kennedy's formula though Kennedy himself was probably not conscious of it. For the factor *r* contains the element *w* as well as *d.*" It is sufficient to say that the essential principle of Kennedy's formula is that already given, *viz.*, that in these self-adjusted channels each *p*, or ratio of width to depth, has its own particular slope s, the equation connecting them being $64{\cdot}4 \left(\frac{p}{p+2}\right)^{\cdot 64} \sqrt{s} = 0{\cdot}84 = \text{constant}$.

In his first formula Mr. Woods connects *w* and *d* with the equation $w = d^{2\cdot 3}$, whence $\frac{w}{d} = p = d^{1\cdot 3}$, *i. e.*, p depends upon d. In other words each *w* must have its particular *d* and, therefore, *p*. The effect of this interdependence is shown on Diagram II by the curve $w = d^{2\cdot 3}$,—the exact value of the index is 2·303,—the interpretation being that silt-stable channels *must* be indicated by it, and, conversely, that channels not so indicated cannot be silt-stable. For example a width of w = 58 must have a depth d = 5·8 and p = 10, whereas it is obvious that for w = 58 there may be a wide range of depths and corresponding values of p *all* denoting silt-stable channels provided each has the appropriate slope of its p. Or, again, it will be seen that six channels lie on or about the line of p = 12, all silt stable and, in this case, with the same slope *s*; but Mr. Woods' curve fixes the width at 81 ft. and the depth at 6·75 ft., giving one channel only for p = 12! Similarly a number of the distributary channels lie along p = 5 all of which would be excluded by Mr. Woods' curve although they conform to Kennedy's conditions.

All the channels indicated by Mr. Woods' curve would have silt equilibrium if they had the slope *s* appropriate to the ratio $\frac{w}{d} = p$ in each case, but the majority have not, as his formula is,—slope $\permil = \frac{1}{\log (D+1)^2}$ and the connection between *s* and *p* or between *s* and *m* is remote. In fact his value of D (the discharge) is fixed once *w* is fixed, whereas the curve of Q (or D) on the diagram shows that the same discharge may be obtained with various widths and depths. Even if the formula conformed with the general principle of Kennedy's, it would restrict the application of it quite unnecessarily, as *any* point to right or left of his curve will indicate a non-silting channel given the slope appropriate to its valve of *p*.

Mr. Woods' third formula (two have been given above is—$V_w = \log (wd) = \log A = \log d^{3\cdot 3}$ or $= \log (d^{3\cdot 3}+1)$ as afterwards modified by him. This curve is shown on Diagram I and compared with V_o and V_B. It approximates roughly to V_o for depths over 2·0 ft. and under 7·0 ft.—the range of Kennedy's observations,—but as already noted the slopes *s* do not always conform to the conditions. Above 7·0 ft. the curve of V_w diverges rapidly, and below 2·0 ft. is not even approximate. For field watercourses and minor channels the formulæ generally are quite inapplicable, and the consequential values for Kutter's C and N deduced in his Table IV indicate something peculiar in the values of s, D, V_w and A.

Towards the end of his article Mr. Woods remarks —"Kennedy's formula has received a certain measure of acceptance throughout the world, but difficulties are indicated by the fact that in different countries engineers have felt it necessary to tamper with the multiplier, or with the index, of *d* . . . . ." In the writer's opinion it is quite consistent (and unobjectionable) to alter the multiplier to suit a different class (or grade) or a different density of silt, in fact Kennedy contemplated this as shown in his hydraulic diagrams. But to alter the index of *d* is to interfere with the general law, and as has been shown any alteration should be in the direction of *increasing* the index 0·64 and not lowering it.

J. F.

SUTLEJ VALLEY PROJECT SUPPLIES.

It is now freely admitted by the Punjab Irrigation Department that, when the Sutlej Valley Project construction is finished and irrigation requirements on it develop, there will be serious trouble in respect of the river supplies that are needed. Accurate daily measurements of the discharges of the Sutlej and Beas tributaries and of canals being worked from them and also of the combined river above the highest weir at Ferozpur and at Adamwahan below the third or lowest weir of the same river, during the last six years, have proved that the Beas supplies alone are hopelessly inadequate. They further prove that, even if the balance of the Sutlej tributary supplies, after satisfying present irrigation requirements on the Sirhind Canal, are added to those of the Beas, the quantities of water will be wholly insufficient for the Sutlej Valley Project. This project is said to be based on only the Beas supply, the Sutlej being reserved for other areas and nothing according to the project, except surplus of floods not always required, to be allowed down to Ferozpur. The Bhakra Dam or Lower Sirhind Canal project, for storing the Sutlej water above the Beas confluence and utilising it in Bikaner and British areas to the East of the Sutlej Valley Project Canals, has *for the present* been abandoned, because the foundations of the proposed dam would be insecure at Bhakra and no better site has yet been found for a storage reservoir on the Sutlej, but as the proscription against the use of the Sutlej tributary supplies in the Sutlej Valley Project Canals has not been removed there remains the possibility of their eventually not being allowed to get as far as Ferozpur and the lower weirs, by Sirhind Canal requirements being increased (*e.g.*, by raising authorised intensities as has already been recently done, and extensions in existing Sirhind Canal irrigation) and by a new weir eventually being built somewhere between Rupar and Ferozpur to catch up and utilise supplies that now pass on below Rupar.

The Chief Engineer who prepared the Sutlej Valley Project admitted that the Beas tributary supplies were insufficient during certain months and promised to arrange for Sutlej tributary supplies being allowed to pass down, as at present, to make up deficiencies when Beas supplies were inadequate and he undertook to further supplement these when necessary with stored Sutlej tributary water to make up the requisite supplies which he considered the Sutlej Valley Project *must* be guaranteed to have as a minimum during certain periods, which he indicated on his table of Beas discharges as requiring additional water from other sources than the Beas tributary. He prepared and gave

the Bahawalpur Council a statement showing the quantities of this additional water that he undertook to provide. He was at the time requested to incorporate these provisions in the project and to make special mention of them. Unfortunately he failed to do so either in the project or in the agreement to which the signatures of himself and representatives of the Indian States concerned were taken immediately after. The only action taken, which was obviously the direct outcome of the knowledge of the deficiency of the supplies provided in the project and of the promise, was to add a paragraph to the agreement to the effect that "if at any time it is found desirable for the more efficient working of the canal system to store water *on the Beas* (italics ours) it shall be optional for the three parties to share the cost of the storage in proportion to the benefits to be received by them." The reply to the President of the Council of Regency to the above proposal was contained in his note presented to the Political Agent of the State at the time:—"In case the Government finds the supplies to be short and not workable and favours the proposal for providing storage works, it will be a question worth considering, whether, in view of the circumstances, it would be just to lay the burden of a proportionate share of cost for this storage on the Bahawalpur State." What he really must have meant was that, as storage works would admittedly have to be provided to give the requisite supplies of the Project and all the remedies suggested by the State were being rejected, the State should not be made to pay later on for rectification to overcoming the consequences of mistakes the Government engineers persisted in incorporating in the project in spite of the objections raised by the State engineers from first to last. In the same note the President wrote:—"To speak plainly, the Council is doubtful about the sufficiency of water supplies, the crucial point on which the utility of the whole scheme turns. As regards the question of supplies, therefore, we leave the final finding to the benign Government, with the request that they will, as protectors of the interests of the Bahawalpur State, make sure upon this very serious matter, and, *if satisfied, will pass final orders* regarding the scheme, bestowing consideration upon the requests that have been made in the paragraphs above." They pleaded that "It is very difficult for them to venture on an enterprise which may prove unsuccessful and thus bring *untold misery* in its train. Their technical advisers do not advise them to accept the project." As a matter of fact their technical advisers had just said at the end of their note of the 25th August 1920, on the 1920 project, after pointing out its most serious defects, the chief of which was the insufficiency of water supplies: "If there is no alternative to acceptance or rejection of the *scheme as it stands to-day, then we most unhesitatingly advise the Council to say that they will not join in.*" This was after detailing the defects of the rough scheme and suggesting that they should be seen too before the Council was requested to accept it. There was nothing dubious or obscure about their advice. Notwithstanding this advice the President with fatal weakness added: "In conclusion we beg to submit that the Council of Regency, after having very candidly expressed their views upon the project and having made suggestions for its improvement, *will accept the decision of the Government, arrived at after full consideration of the details set forth by them.*" As a matter of fact they knew they were doing wrong, but they also felt that acceptance was expected of them and they succumbed after a good fight. Their suggestions were all set aside at the time and many hard things were said by the Punjab engineers and the captured Agent, about the Bahawalpur technical advisers who had dared to criticise and oppose any of the views of the sponsors of the project.

In forwarding the note of the Council of Regency to the Punjab Government the Political Agent of Bahawalpur wrote on the 1st September 1920, three days before the agreement was signed by the President of the Council of Regency: "I am completely convinced of the beneficial nature of the scheme and consider that there are no substantial grounds for nervousness on the part of the Council." Then referring to their offer to abide by the decision of Government, the Political Agent helped with: "It will be seen from the last paragraph that the Council accepts the schemes, but leave the decision of certain points to the Punjab Government. *As I understand that the Punjab Government are prepared to take the responsibility that the irrigation expected in the project will be achieved, the acceptance is therefore a definite one.*" It will be obvious to anyone reading the history of 1920 containing the above that the definite acceptance was on the part of the Agent and not of the Council. This was nevertheless described with admiration as "*a diplomatic way* of assisting the Council of Regency *to come to a decision* in the final stage under very difficult circumstances."

Notwithstanding the admissions of water shortage of the Chief Engineer who prepared and submitted the project of 1920, work on which was started in 1922, his successor, who had the refutation in his own office, wrote in March 1922: "In the summer months there is sufficient water for all. In the winter there is sufficient in the Beas alone for all the perennial area of the Sutlej Valley Canals, the project for which has therefore been prepared on this basis entirely, so that the withdrawal of the stored water in the proposed Bhakra reservoir does not come under consideration at all." This was an extraordinary statement for the most responsible officer connected with the project to make. It was acceptable only by those who wanted to believe it.

On the basis of the discharges of the Beas of the first 20 years of this century, INDIAN ENGINEERING of the 9th July last showed that supplies were insufficient. The figures of old discharges have at times been held to be unreliable. Now, however, their reliability has been established by the careful daily discharge observations that have been made since 1921-22 and the alarming fact has been confirmed and admitted on the new figures entirely

Taking considerable risk in adopting, for the purpose of calculating available supplies for the project, average discharges of the river for long periods relating to agricultural operations (such as 6½ weeks, mid-October to end of November, as sowing time for Rabi and the whole of June as that for getting in the Kharif crops), and thus securing the enhancing effect of high supplies and freshets of limited duration on the averages received at present, and including *both* tributaries, though the project is supposed to have a lien on only the Beas, we find that during the four years 1921-22 to 1924-25 the discharges in total range from 5,000 to 13,000 cusecs for Rabi and from 5,000 to 38,000 cusecs for Kharif. The full supplies adopted in the project as required for sowing full project areas are 13,000 cusecs in Rabi and 38,000 cusecs in Kharif. Therefore, apart from the fact that the technical data used in the project is under dispute as not being in accord with experience and that the Sutlej tributary supplies are intended to be eventually used up elsewhere, it can be seen that there will always be insufficient water. Taking even averages of four years' averages of discharges for the long periods mentioned and thus further stultifying results by masking deficiencies that will be experienced in years of persistent, continuous shortage, it is found impossible to conceal the state of affairs any longer. Space will not allow of our quoting the detailed examination we have made and we shall therefore reproduce only the following abstract table incorporating discharges taken from the Government records. When the Sutlej tributary supplies are deducted the figures will present a more serious aspect even than those we now give as the very best that can possibly be expected. The remarks column of the statement shows what will happen in such years as those for which

figures are available without allowing for a suitable coefficient for qualifying the too optimistic data of the project. If Lower Bari Doab data are adopted for calculating requirements of project cropping, then the supplies will be seen to be hopeless except during high flood seasons, usually not synchronising with absolute requirements.

Average River Supplies of Combined Beas and Sutlej during the four years 1921-22 to 1924-25.

The discharges given are the totals of the figures for the river at Adamwahan railway bridge added to the supplies used in inundation canals between Ferozpur and Adamwahan. The groups of four figures under each period relate to each of the years mentioned :—

Average river supplies available.	Remarks relating to possible irrigation results.
I. Rabi sowing, 46 days.	
9,638 or 74 % of full 10,481 „ 81 „ 8,434 „ 65 „ 13,000 „ 100 „	No possibility of full requirements of sowing being obtainable in 3 years out of 4.
II. Rabi second waterings, 62 days.	
5,579 or 43 % of full 5,882 „ 45 „ 7,139 „ 55 „ 7,439 „ 57 „	In every year it will be impossible to maintain for the long period of 2 months even the reduced cropping of the sowing period.
III. Rabi final waterings, 74 days.	
5,881 or 45 % of full 8,337 „ 64 „ 6,139 „ 47 „ 5,252 „ 40 „	In every year there will be no possibility of getting over half project Rabi. Shortage will be for the whole season in 3 years and 4½ months in the 4th year.
I. Kharif sowing, 46 days.	
8,518 or 22* % of full 10,917 „ 29 „ 5,081 „ 13 „ 6,104 „ 16 „	After Rabi failures will follow 6 to 7 weeks of shortage for sowing Kharif each year to extent of ¾ to ⅞ of expected project area.
II. Kharif second waterings, 30 days.	
25,909 or 68* % of full 16,742 „ 44 „ 10,558 „ 28 „ 20,799 „ 55 „	Slight improvement of supply in June could save more Kharif if the crops existed, but would prove useless to some extent owing to I. Kharif shortage.
III. Kharif flood waterings, 107 days.	
37,917 or 100 % of full 37,917 „ 100 „ 37,917 „ 100 „ 37,917 „ 100 „	Full supplies are too late for Kharif and only partly available for use in obtaining Rabi first waterings in only non-perennial areas.

From the above figures it is easy to see that Rabi cropping would have been very low and Kharif still lower. The two consecutive years 1923-24 and 1924-25 would have been veritable famine years for the Sutlej Valley Project Canals.

The engineer in charge of the Discharge Division, whose special duties require him to ascertain what supplies can be allowed to pass on to Sind for the Sukkur and Lower Indus Canals, writes in September 1925 about the Sutlej Valley Project supplies found from accurate measurements to be available : "On the Sutlej full share capacity not available in two years out of four and in other two years hardly available. Full supply always available in July." The "share capacity" is a reduced figure, arrived at by taking only two-thirds maximum capacity of non-perennial channels, used in the project for Kharif periods when the river is not in flood and does not appear to have any useful meaning. Even so and even with the Sutlej tributary supply added and with other ameliorative assumptions, the special officer has to admit that there will never be enough water for the project, except during high floods.

* In project the use of "share capacity" (⅔rds full supply) exhibits a 50 per cent. higher percentage than is here given for I and II Kharif.

Regarding the prospects of the project there is said to be considerable nervousness in the Bahawalpur State, which is borrowing at 6 per cent. for construction. Examining the discharge figures it is not difficult to arrive at the conclusion that the irrigation returns may be cut down to far below those that were given in the forecast of 1920. We understand also that the returns for sale of State waste lands are very disappointingly below what they were estimated to afford. The revised estimated cost of the project had mounted upwards by the end of 1926 (we do not know if it has gone any higher since) by 53 per cent. Simple calculations will enable anyone interested to arrive at the prediction that the percentage of earnings is going to be very much below the 42 that the Council of Regency were invited in 1920 to gaze at and try to secure for His Highness the minor Ruler of Bahawalpur. Unless the earnings can be more than 6 per cent. of capital cost, what is going to happen to the State? The presentation of imaginary figures has had the desired effect up to a certain point, but the time has arrived when nothing can hide the truth any longer. It is the business of responsible authorities to try to avert disaster. Storage and other improvements in the valleys of the Sutlej and Beas in the hills are now due.

The Gazettes.

Punjab, January 13, 1928.

Buildings and Roads Branch.

Lala Dwarka Prasad Nayar, who, as a passed Engineer student from the Thomason Civil Engineering College, Roorkee, was posted to the Punjab Public Works Department, as an Apprentice Engineer, completed one year's practical training on 31st October 1927, and is hereby appointed to the Punjab Service of Engineers as an Assistant Engineer on probation for a further period of practical training for one year, with effect from 1st November 1927.

Irrigation Branch.

Mr. N. G. Watson, Temporary Engineer, attached to the Public Works Department, Punjab Irrigation Branch, is allowed, by the High Commissioner for India, 2 months' leave on half-average pay on medical certificate in extension of the leave granted to him previously.

Mr. J. H. Sullivan, Executive Engineer, attached to the Public Works Department, Punjab, Irrigation Branch, is allowed leave on average pay for 2 months and in continuation leave on half-average pay for one year and 8 months, in extension of the leave granted to him previously.

Lala Radha Kishan Saksina, Assistant Engineer, on transfer from the Ferozepore Division, Sirhind Canal, which he left on 2nd December 1927, joined the Orki Division, Bikaner Circle, Sutlej Valley Project, on the 7th idem.

Lala Bhagwan Dass, Temporary Engineer, on transfer from the Weir Division, 1st British Circle, Sutlej Valley Project, which he left on 1st December 1927, joined the Panjnad Weir Division, 3rd Bahawalpur Circle, Sutlej Valley Project, on the 12th idem.

Lala Bishambar Sarup Mathur has been appointed a Temporary Mechanical and Electrical Engineer and posted to the 1st Bahawalpur Circle, Sutlej Valley Project, with effect from 5th December 1927.

Lala Amin Chand, Assistant Engineer, on transfer from the Eastern Division, 2nd British Circle, Sutlej Valley Project, which he left on 26th November 1927, joined the Abbasia Division, 2nd Bahawalpur Circle, Sutlej Valley Project, on 6th December 1927.

Lala Khanda Ram Kalra, Assistant Engineer, on transfer from the Abbasia Division, 2nd Bahawalpur Circle, Sutlej Valley Project, which he left on 13th December 1927, joined the Qaimpur Division, 2nd Bahawalpur Circle, Sutlej Valley Project, on the 15th idem.

Mr. W. F. Smith, officiating Executive Engineer, Montgomery Division, Lower Bari Doab Canal, took over charge of the Khanewal Division, Lower Bari Doab Canal, in addition to his own duties on 9th December 1927, from Sardar Bahadur Bawa Shiv Singh Bedi, Assistant Engineer, who proceeded on leave.

Lala Arjan Dev Khanna, Temporary Engineer, on transfer from the Montgomery Division, Lower Bari Doab Canal, which he left on 14th December 1927, joined the Okara Division, Lower Bari Doab Canal, on the same date.

MR. WALTER CAMPBELL MORGAN.

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INDIAN ENGINEERING.

SATURDAY, JANUARY 28, 1928.

A BRILLIANT PUBLIC WORKS OFFICER.

VERY rarely can there have been an officer of any of the services of India who possessed the same brilliant all-round abilities and made so little use of them for self-advancement as Mr. Walter Campbell De Morgan, late of the Madras Public Works Department, whose death we regret to learn occurred on the 13th October last. He came of a clever family and inherited many of the family characteristics. He was almost an Admirable Crichton in his many-sided ability. He was a first-rate draughtsman and artist, and he excelled in music. He sang a good song, and his ear was so true that he could hear an opera for the first time and afterwards whistle it from end to end without a fault. He was a wonderful classic, he won an important prize for Greek at the age of ten, and to the end of his life he read Homer for the pure pleasure of it. He had a passion for science, especially for biology, though he was also a botanist, and during a summer in Cornwall he identified and catalogued the local flora. His memory was prodigious, he could read a page of poetry or prose, close the book, and repeat it word for word. And to his mental equipment he added a physical constitution which was immune to lassitude or fatigue. With his intellectual assets he might have reached the topmost rung of the ladder of almost any profession he had chosen to adopt—if he had wished. But then he did not wish, he had no ambition to hitch his wagon to a star for the sake of achievement and applause, and he cared nothing for the opinion of the world in general. To the normal man the good opinion of the world is a guide to conduct, but no one ever concerned himself less with *pro rege, lege, grege* than De Morgan. In his fearless independence of outlook he had no bump of reverence for authority, he was a law unto himself, and to him the voice of the people was not the voice of God. He "walked his own wild road whither that led him," and it was not the sort of path to lead to success or preferment. As far as his service in the Public Works Department went, he retired a Superintending Engineer, without professional distinction.

Mr. De Morgan was born on the 1st March 1852, and was one of the first batch of successful candidates to enter the Royal Indian Engineering College at Coopers Hill on its opening in 1871. Both academically and in the field of athletics it was a very remarkable batch, seldom has there been such a group of fine young fellows to enter the doors of any institution of the kind, and in that company Walter De Morgan had it in him to be in the first flight. No one knew why he had chosen the profession of engineering, he showed no indication that he was fond of it, but he was so gifted that he could have done anything if he had tried, and it was pathetic that he should not have cared to try. He was good at games, he played both cricket and football, but the captains of the Eleven

and the Fifteen dared not play him in a match, because it was never known what his perversity might not lead him to do ; and in the final examinations he passed out last. He had declared that to be his intention, so it was said, and for a man of his brains it was not altogether an easy task. He might of course have fooled, but then he might not have qualified, and to pass out last and yet to qualify in every subject meant some exactitude of method. If, however, that was his aim, he achieved it, and on obtaining his appointment to the Public Works Department of India, he was posted to the Madras Presidency. As regarding his College career, that was probably the general impression that his fellow-students formed of him, except that he was personally always the best of company, especially at the "sing-song" gatherings, where his Irish songs were much in request.

In his younger days in India, the stories of his freaks and pranks were legion. On one occasion, annoyed at his house by the ringing of an adjacent church bell, he waited till the congregation were at Sunday service, and then proceeded to plug the bell with a small-bore rifle, causing sounds within the building like minute guns at sea. On being taken to task for his behaviour, he explained with his accomplished insolence that the bell was an excellent target, it always told (tolled) when it was hit. There was also the occasion when, superintending a musical meeting, he suddenly sent for one of his Assistant Engineers and put him up to sing "Two Lovely Black Eyes," although the programme was one of sacred music. He delighted in these feats of humour, he never cared what he did or said, and perhaps because they were all regarded merely as De Morgan's "pure cussedness" no trouble ensued. The incidents certainly added to the gaiety of Madras. In the Department, as a rule, he just did his duty, as at Coopers Hill he had set himself to just qualify in the examinations, generally speaking it was not much more than that. Yet, it is known that as an Executive Engineer he carried out the Rushkuliya irrigation project of the Ganjam district exceedingly well. The project was a protective work, it comprised three masonry dams across three rivers and two large reservoirs with earth banks, holding up 45 and 28 feet of water. There were nineteen miles of canal between the anicuts, and fifty-four miles of canal with sixteen branch channels to feed the old reservoirs, seven hundred in number, which formerly had been supplied by precarious rainfall. It was a complicated little project, and orders in matters of detail were frequently required. The Superintending Engineer, a capable officer, was slow and indecisive in making up his mind, and Mr. De Morgan, it was currently said, used to telegraph to him that unless he gave definite instruction on this, that or the other point, within twenty-four hours, certain action would be taken. The orders never came, and the project was completed effectively and with great promptitude.

The success of the Rushkuliya scheme showed that Mr. De Morgan was a competent engineer when he liked, and his assistants on the work had a great love and admiration for him. But because he did not always care to extend himself in his duties, some people thought him indolent. He was not indolent, he was of exuberant energy, was always busy in his way. He read scientific subjects with avidity, and his tenacious memory for anything he read gave him a very wide range of knowledge. In science he might have been called a *savant*, but not a pedant poring over books in a library, for he was physically very active, a daring horseman, a good small-game shot and a fine fisherman. But study he did, and in company if it came to a game of intellectual fence he was the best man there. The information his reading gave them was surprising, and he would produce facts and figures to refute the unwary like a conjuror taking rabbits out of a top-hat. Every one who knew him called him "brilliant," and he was not called that for nothing. He reached the rank of Superintending Engineer, and occupied that position for some years before he retired in 1904 at the age of fifty-two, doing reputable but not work of any mark. He was not superseded and he had still three more years to serve, but he said that he did not want to be a Chief Engineer and Secretary to Government. He had a scorn for the Secretariat and red tape and officials struggling for honours and rewards. He was a born rebel about some things, and *fumum et opes strepitumque Romæ* had no attractions whatever for him. He probably retired for the sake of occupation which he felt would be more congenial to him.

Some men have minds in such perfect balance that they can do themselves justice in whatsoever sphere of life they may be cast, others seem to be always in conflict with their fate, but even with the latter there is sometimes harmony at the end. It was so in Mr. De Morgan's case, on his retirement from Indian service he applied himself to zoology, one of the subjects in which he had previously been interested. He attended a course of study, including practical laboratory work, at the University College, London, and early in 1906 went to Plymouth for research work at the Marine Biological Laboratory, where he laboured almost to the date of his death, acquiring a great reputation as an observer and for his skill as a draughtsman in representing the animals he studied. He wrote, independently or in co-operation, many valuable papers on the scallop, *Pecten maximus*, which was an attempt to study the fundamental problems at the back of cancer research; on sea-urchins, *Echinoderms*, one of his most important works; and on marine protozoa, of which it was said that it was a remarkable testimony to his great powers of work and ability, especially as this series of papers was written when he was over seventy years of age. He had been called "brilliant" at Coopers Hill and in Madras, and his research in the realms of marine zoology led him to be called "brilliant" once more and with stronger reason by the expert scientists of the day. Not only that, he was said by them to have been a man of charming and vigorous personality, whom it was a pleasure to have been in association with, and whose death made them the poorer by the loss of an exceptionally broad-minded and sympathetic friend. And throughout that busy time of

some twenty-two years, following thirty years of service in India, he continued his reading on almost every subject, and maintained his interest in the classics to the end. Homer he read practically every day.

It is an amazing story, and it is not a little pitiful that so many of the best years of Mr. De Morgan's life should have been wasted. It is hardly comprehensible that he would have fooled away his time in pleasantries or unpleasantries if he had not felt the strain of having to fit his square shape into the curves of a circle or his circle into the angles of a square. Nor in India was he the sort of man that is wanted in a bureaucratic Government, India prefers placidity to brilliancy, and the average man to the man who is so brilliant that he is like a pyrotechnist with a pocket full of squibs. That is why Mr. De Morgan's intellect was so much greater than the results which might have been expected from it. If he had been sent to Oxford or Cambridge, in quite another atmosphere of competition, he would have taken a high-class degree, and embarking on scientific research he might have made for himself a world-famous name. A man who could read Homer like a novel was not in his niche at Coopers Hill, and in India it can be imagined how he chafed under official restraints. All the same, he was one of our engineers, and of the Coopers Hill engineers who gained distinction, he was, when he found himself on retirement in his true vocation, the brightest jewel of the crown.

EGYPT AND MALARIA.

In December last, the great irrigation engineer, Sir William Willcocks, delivered a lecture, entitled "Why is Cultivated Egypt Immune from Malaria?" at Cairo, and any new information on such a subject must obviously be of interest to malaria-stricken India. If there is a country which by reason of its climatic and other conditions should be eaten up by malaria, it might well be thought that it would be Egypt. Yet the cultivated Nile valley from Aswan to the Mediterranean is immune. There are places on the edge of the cultivation like Ismailia and the Khanka desert farm where malaria occurs, but they are not cultivated Egypt. It was shortly after the construction of the sweet water canal to Ismailia that marshes formed in the depressions north-east of the town, and Ismailia was decimated by malaria. It was after some years of irrigation at the Khanka farm that clear seepage water showed itself in the low-lying land, and there was a severe outbreak of malaria. There is nothing in the climate or physical conditions of Egypt to keep the scourge in check, it can be as bad in Egypt as anywhere else where the conditions are favourable to mosquito life, but there is no malaria in cultivated Egypt. Sir William Willcocks says that during all the long years he slept in a tent or in the open between rice fields, surrounded by marshes, and travelled about the delta on foot or in a boat, he never had a touch of fever. It was not that he was himself immune, he went to Greece to report on the reclamations of Lake Copais and in spite of every form of screened protection he suffered badly, he suffered in other places, but not in Egypt. Neither he nor the men who accompanied him on his tours contracted the disease, nor did they ever see anyone with it.

In these circumstances, Sir William had for years tried to solve the problem of the immunity of Egypt from malaria with no success. But a comparatively few months ago, Dr. Bateman of the Old Cairo Hospital, read him some extracts from Dr. d'Herelle's work, "Immunity in natural infectious diseases," in which he gave reasons for the immunity of certain districts in the Argentine and reclaimed areas in Holland from malaria; and Dr. Bateman added: "It is our clover which protects us." He then went to Mr. Gray, director of the chemical laboratory of the Ministry of Agriculture, and consulted him. Mr. Gray replied that on the face of it, it was clover. With this clue, Sir William carried his studies further. Egypt has, in a wild or cultivated form, a wealth of clover and leguminous plants. All over the irrigated areas, ideal breeding grounds for mosquitoes throughout the year, where there are swamps, stagnant pools, sluggish drains, there are also the clover fields "like sentinels over the health of the perennially irrigated delta," and in addition to the clover there are extensive areas of legumens, beans, lentils, lupins, fenugreek, chick-peas (Indian gram) and ordinary peas, with a strong contingent of wild clovers, vetches and peas. Countries, neighbours of Egypt, have poor leguminous crops and have been plagued with malaria from time immemorial; Alexander the Great died of malaria trying to reclaim the marshes of Babylonia; during the war our men suffered in Palestine, Salonika and elsewhere; but apparently from the earliest antiquity Egypt has been protected by its wealth of leguminous crops, especially of clover. There is every opportunity for the malaria mosquito to propagate malaria, and there is no malaria. In Dr. d'Herelle's book, it is said that the greater part of the Argentine is completely free of malaria though mosquitoes abound, and in all the free regions there is a wild, scented clover, on the juice of which, containing coumarin, malaria mosquitoes feed; and the author suggests that coumarin may play a rôle in the insects comparable to that which quinine plays in man. The mosquitoes which cause malaria in man are carriers of malaria, to give malaria they must have malaria to carry, and if they are themselves free from malaria their bites cannot induce the disease. There would therefore appear to be something in the leguminous plants, particularly in certain kinds of clover, which makes mosquitoes immune.

If that is the case in Egypt, there would seem to be no reason why appropriate action should not be taken elsewhere. The conditions of different countries vary, but there is a very wide range of clovers and legumens, and it should be possible by experiment to select *suitable* leguminous plants for the purpose in view. Incidentally, clover has other values, it is not cultivated in Egypt ostensibly to stamp out malaria, it is a valuable fodder crop for cattle, and in Egypt and Uganda it is alternated with an exhaustive crop like cotton in order to maintain the yield. Sir William Willcocks concluded his lecture with the words: "It would pay any malaria-ridden country to write to Washington and get information from people who have first-hand information and are ready to give it; to buy the hardy sweet clover from local seedsmen in the Western States and begin operations in suitable gardens and nurseries; to send specialists to collect the seeds of the 'trebol de olor' and local clovers in the Argentine; to get the wild clovers which grow under lupins and in the open in Northern Europe and Southern Egypt; to get the seeds of the fodder crops of Egypt; and to get the coumarin beans and seeds from Guiana and Brazil, and plant them. . . . Malaria is such a terrible curse and its suppression over the face of any country by changing malignant malaria mosquitoes into benign ones would be such a blessing that no one

responsible for regions where malarial fevers are the common heritage of the people should find it possible to contemplate cultivated Egypt's immunity from malaria and shrug his shoulders and do nothing." It is only very briefly that Sir William Willcocks' presentation of his case has been given here, the whole paper merits the attention of authorities in India, and it is hoped that the notice of medical officers and agricultural experts will be drawn to it.

DEATHS OF TWO VETERAN ENGINEERS.

We much regret to have heard the news of the deaths of Mr. Robert Burton Buckley, C. S. I., and Mr. John Montriou Campion on the 19th and 20th December last respectively. They were engineers who were born within a few days of each other in August 1847, and, passing the same examination for the Public Works Department of India under the system in force prior to the foundation of Coopers Hill, they both arrived in this country in the autumn of 1869. They were both, moreover, men of great vigour of constitution, who did much active work long after their retirement from Indian service, and who maintained their physical health and mental faculties unimpaired almost to the end.

Mr. Buckley, a son of the Rev. John Wall Buckley, vicar of St. Mary's, Paddington, was educated at Merchant Taylor's School and won the Whitworth Scholarship in mechanical science in 1869. It is an important scholarship which it is of considerable credit to win, and it still has a function in the shape of an annual dinner. It was at that dinner that Mr. Buckley took the chair as recently as 1926. On receiving his appointment to the Public Works Department, he was posted to Bengal, and on account of his mechanical knowledge and ability he was on first arrival placed in charge of the Dehri Workshops Division of the headworks of the Sone weir, more than two miles in length. The Sone Canals project is the largest, most important and most successful of all irrigation works in which Bengal had embarked, and Mr. Buckley at the time he first joined these canals and later had a large share in their construction. It was no doubt because he gained his first practical experience of work in India on irrigation that he made irrigation engineering a speciality all his life; and great engineer as he was, it is a little pathetic that he should have been afforded no greater opportunities for distinction than those of a province like Bengal. He ought to have been in a great irrigation province of the potentialities of the Panjab, where the late Colonel Sydney Jacob, R. E., and the late Sir Thomas Higham, conspicuously good men, were doing so much to raise irrigation in the province to the position it ultimately attained, and to whom he would have been an invaluable companion in arms. For he was a real engineer, not a mere official, though as an official also he was exceedingly competent. He was well-read, he had a cultivated and acute mind, he took broad views, and personally he was a colleague with whom it was always a pleasure to work. But it was not that he was not distinguished in Bengal, his great abilities and personal character would have brought him to the front wherever he was. As Assistant, Executive and Superintending Engineer on the Sone Canals, he did excellent work in all capacities. The system has three canals, the Arrah, Buxar and Patna, the Patna is the largest, and in executive charge of it Mr. Buckley carried it to completion. In charge of the Sone circle, he again did much for the system, and also conceived the idea of the two canals from the Gundak which were constructed when he became Chief Engineer. In the meantime, like most officers of worth, he had been drawn to the Secretariat. He was Under-Secretary for Irrigation, Roads and Buildings in Bengal, and afterwards filled the same position in the Government of India for nearly three years. For some little time he acted as Chief Engineer of the Calcutta Municipality, and made himself so popular that he was consulted after he had left. As Chief Engineer and Secretary to the Bengal Government, he was also a member of the Council of the Lieutenant-Governor, and in 1901 received the honour of the C. S. I. He was under the age limit when Sir John Woodburn, who had a high opinion of him, offered him the Chairmanship of the Calcutta Corporation, but he had been then for many years separated from his children, and he decided to decline the appointment and to retire from Indian service in 1902.

He retired, however, in good health and full of energy, and set himself to produce his second and much improved edition of his work on "Irrigation in India," which had first been published in 1893. It is a book which is now in some ways out-of-date, but it was a pronounced success when it appeared and had a vogue far beyond the confines of India, while in India it was a standard work of reference and is still consulted. Mr. Buckley followed this up with a volume, "Facts, Figures, and Formulæ for Irrigation Engineers," based on the mass of notes he had collected during his thirty-three years' service in India, mainly for his own use, but published for the help of his brother irrigation engineers, and of help they undoubtedly have been. He also published at different times papers on technical subjects, showing how keenly he retained his interest in his profession; and his reputation caused him to be consulted on irrigation works in Spain and on the public works of the Sudan. Mr. Buckley, who, it may be mentioned, was a brother of Lord Justice Buckley, afterwards Lord Wrenham, was unquestionably a distinguished engineer, and a loyal comrade his death will be deplored by all those who knew him as a friend.

Of Mr. Campion, inasmuch as we have recently published a full account of his services, it is unnecessary to say very much. He was first employed in India on State railways, and was subsequently transferred to the Buildings and Roads branch of the Public Works Department in the Panjab, a province in which his cheery temperament and pronounced views on all subjects made him widely known. But it was during his retirement that his services were of a more exceptional kind. It was when Lord Morley was Secretary of State for India that it was found desirable that there should be an experienced engineer officer in England to guide young engineering students studying in the country. The charge was one of considerable responsibility, and Mr. Campion, who was selected for it, fulfilled the duties expected of him with great tact and conscientiousness. He retired from the post a short time ago on approaching the age of eighty years, and remained, even when he had ceased from active work, the same breezy, forceful personality he had been throughout his life. He had served India for something like five decades and a half, and was in excellent health till the last few days preceding his death. Both he and Mr. Buckley are examples of men who have proved capable of doing much effective work long after the superannuation age of fifty-five in the Public Works Department.

Notes and Comments.

Aid for Research.—The Standing Finance Committee of the Legislative Assembly, which met at New Delhi on the 23rd instant, sanctioned the grant of Rs. 7½ lakhs to the Indian Research Fund Association. The grants to the Benares and Aligarh Universities on last year's scale were also sanctioned.

Turner, Hoare and Co., Ltd.—This celebrated engineering firm of Gateway Building, Apollo Bunder, Bombay, have issued a new 1928 price list, which all engineers would do well to procure a copy of for filing for reference in their offices. The price list is beautifully illustrated and handsomely got up, and is altogether an artistic production.

More Ports Wanted.—On a motion in the Ceylon Legislative Council on the 19th instant, the Government have undertaken to enquire into the feasibility of opening one or more ports in the Jaffna district for traffic and trade with South India. These ports were closed some years ago on account of plague and cholera and had since been lying stagnant.

Bhatpara Municipality.—The Government of Bengal Local Self-Government, have sanctioned the revised scheme for the construction of a road, about five miles in length and sixty feet wide, within this Municipality. The road will run parallel to the existing Trunk Road. The scheme also provides for the construction of eight other roads and two parks between Kankinarah and Shamnagore.

Bharatpur State's Affairs.—The "Pioneer" understands that His Highness the Maharaja of Bharatpur having accepted the advice of his Excellency the Viceroy concerning the administration of his State, no further announcement will be made regarding the course of affairs in Bharatpur. The advice given requires the appointment as Diwan of an officer of the Government of India. Information regarding the award is likely to be available soon.

Calendars.—We have received the following with thanks:—W. H. Harton and Co., wall calendar; Survey of India, wall calendar; Siemens (India) Ltd., wall calendar; The Photographic Stores and Agency Co., wall calendar; S. G. Brown, Ltd., wall calendar; Globe Nursery, wall calendar; Sulzer Bros., refills for desk calendar; Braithwaite and Co. Engineers Ltd., pocket diary; Corporation of Calcutta's Year Book for 1928; Muir Mills Co., Ltd., date card.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 12th January 1928:—Messrs. Martin and Company, Calcutta—1 lot spares, for 300 Ruston dragline, Rs. 8,836 c. i. f. Karachi; 1 lot spares, for 300 Ruston dragline excavator, Rs. 1,117 c. i. f. Karachi; Messrs. Jessop and Co., Ltd., Calcutta—183 Joists, J. S., of sizes, Rs. 1,733 f. o. r. Howrah.

E. I. Railway Workshops.—Ten thousand workers of the Lillooah workshops of the East Indian Railway suddenly went on strike on Monday last, demanding, it is alleged, an increase of wages, although it is reported that the immediate cause of the strike was due to some friction between the workers and the workshop authorities. The strike came to an end on Tuesday, the management having assured the men to look into their grievances. The last strike at these workshops took place in 1920.

British Industries Fair.—All the space in the London section of this Fair, to be opened at the White City next month, has now been taken by manufacturers, and the Department of Overseas Trade announced on the 21st instant the formation of a waiting list for the Fair of 1929. Acceptances from overseas buyers to the Government's invitation to the Fair shows an increase of more than 100 per cent. of those received at the same stage last year. A record number of buyers are coming from 67 countries.

The Calcutta Tramways Co., Ltd.—The Agent of this Company, in the course of a letter addressed to the Chairman, Calcutta Port Commissioners, stated that "the Calcutta Tramways carry on the average 250,000 persons per day. This service is performed with a maximum of 250 cars on the road, of which nearly 70 go off during the slack hours. The average fare paid per passenger per mile is about 3 pies." The Howrah Municipality have decided that it is desirable to make provision for laying a double tramway track over the proposed new Howrah Bridge.

Chinsurah Water Supply.—With a view to improving the water supply at Hooghly and Chinsurah the Commissioners of the Hooghly-Chinsurah Municipality have framed a scheme at an estimated cost of Rs. 1,95,000. If the scheme is approved the present steam engine will be replaced by an oil engine and 300 more house-connections will be given. The Government of Bengal, Local Self-Government, will contribute one-third of the amount. The Municipality will take a loan of Rs. 70,000, and the balance will be met from the house-connection fees.

Amritsar Municipality.—Khan Bahadur Khwaja Ghulam Sadiq, of the Amritsar Municipality, recently sought the concurrence of the house in an expenditure of Rs. 700 for erecting a pump on the Nichol Park Tube Well, the Chief Electrical Engineer having offered to get the work done for this sum, though the original estimate was for Rs. 1,600. Several members expressed surprise at this discrepancy, and L. Kesho Ram severely criticised the new estimate and urged that it be submitted to the Government Engineer. The estimate for Rs. 700 was sanctioned.

Dacca District.—There is need for more bridges in this district. Some of the leading men being consulted said that they were in favour of a tax of two annas on petrol for road development and also favoured the creation of road boards. They said that waterways in the Dacca Division were much used for traffic. Motor transport would be developed with improved roads and would be appreciated by the people and lead to village prosperity and that roads in the Dacca District needed more bridges. Where bridging was not possible ferries of the right type should be maintained.

The Sarda Canal.—In the review of the Governorship of Sir William Sinclair Marris, which has just closed, mention is made of the Sarda Canal Scheme which has been pushed through. It is stated that the service morale has been restored and the problem of corruption after full ventilation in the Council has been tackled in a statesmanlike fashion. "If therefore local self-government presents many disappointing and even disquieting features, this is in the main due to the deliberate policy of extending the principle of self-government to local bodies, and of allowing them to learn by their own mistakes." The history of the Sarda resembles that of several other schemes started immediately after the war.

Staff Changes, B.-N. R.—Mr. S. R. Das, Assistant Commercial Officer, Nagpur, proceeds on three months' leave. Mr. A. C. Chatterjee, Assistant Commercial Officer, Adra, is transferred to Nagpur. Mr. Sukumar Sen, Assistant Traffic Superintendent, attached to the office of the Superintendent, Claims, is transferred to Khargpur, as Assistant Commercial Officer. Mr. G. A. R. Hill, Assistant Commercial Officer, Khargpur, is transferred to Khurda Road, as Assistant Transportation Officer. Mr. N. A. Shad, Traffic Probationer, is transferred to Adra, under the District Commercial Officer.

Bombay Corporation Financial Difficulties.—The Budget statements of 1928-29 show Rs. 327 lakhs as the expected income and Rs. 333 lakhs as the estimated expenditure. The report says the expenditure is increasing daily and next year compulsory primary education to be introduced in two more Wards will cost Rs. 4 lakhs and the remaining Wards are to be provided later on. "Our Development Schemes are undertaken at the instance of the Government direct or under the influence of the Government through the Executive. These Schemes are a heavy burden on the city. It would therefore be but fair if the Government were to relieve us from this burden to enable us to utilise our resources for the good of the city and of the citizens in other directions."

The Concrete Association of India.—This now well-known Association have opened a branch office at E2, Clive Buildings, Clive Street, Calcutta, and are most anxious to get into touch with engineers and others interested in concrete work. The Association is equivalent to that operating in England, America and elsewhere, and its object is to promote the growth of concrete work and improve it in this country, by giving expert advice on all matters pertaining thereto, examining aggregates, sand, cement, etc., and by the distribution of various pamphlets :—(1) Concrete. How to make it. (2) Concrete. Floors and footpaths. (3) Mass Concrete. (4) Recommendations concerning Reinforced Concrete Works. (5) Concrete roads for India. (6) Proper storage of Portland Cement. The Association is doing excellent practical work and is worthy of all support.

Exploration of Abyssinia.—A party of Americans, consisting of Mr. and Mrs. Peters and Dr. and Mrs. Nickerson, is visiting the country in the hope of making a substantial contribution to the store of general knowledge regarding the country, its ancient customs, economics, government and religion. Mr. Peters thinks the status and nature of Abyssinia is destined to undergo a complete change soon. The influence of the Coptic Church on the civilization of the country will be one of the subjects to be dealt with. Another will be the study of the judiciary, which permits of the choosing of a man from the street to sit and pass judgment upon the merits of a case. Mr. Peters hopes to obtain still and moving photographic records of the life and features of the country. Dr. Nickerson will take special interest in the mode of living as compared with that of so-called modern civilizations. He will investigate the effects of the raw meat diet of the Abyssinians on them. The party will travel by rail from Jibuti in French Somaliland to Adis Abeba, the capital of Abyssinia. Abyssinia appears to be destined to become the hunting ground of explorers, whether the people like it or not, before long.

Indian Sterling Loan—Post-war Projects.—The marked success of the sterling loan of £7½ million that the Secretary of State has arranged for India at 4½ per cent. interest and £91½ per cent. issue price, has greatly benefited Indian securities. Three per cents. have risen to 61⅞; three and a half per cents. to 72 and five and a half per cents. to 101⅜. From one point of view the fall in the price of money must cause a certain amount of regret among those responsible for rushing into heavy expenditure with several large projects that were carelessly prepared immediately after the war, when it cost as much as 6 to 6½ per cent. to borrow. The Back Bay, the Sarda Canal, the Sukkur Barrage and the Sutlej Valley projects are perhaps the worst examples. Each of them was started on a low estimate, which was revised, often more than once, immediately after sanction, and construction was breathlessly plunged into when money was at its highest and rates for works at their worst. It would be interesting, academically, to sit down and calculate what money could have been saved if more prudence had been exercised by those responsible for each of these projects, and their execution had been postponed for ten years. The extra time could have been profitably spent in the preparation of sound projects on complete surveys and investigation. Very different would have been the history of each of these schemes from what it has been.

Great Britain and Egypt.—The Egyptian newspaper "El Mokattam" learns from well informed sources that since Sarwat Pasha returned from England agreement has been reached on all matters discussed, except on the most important, which are the removal of British troops to the eastern side of the Suez Canal and the question of the Sudan. Negotiations are proceeding with regard to Egypt's ancient rights in the Nile waters and the appointment of an Egyptian Secretary to the British Governor-General of the Sudan. These last are the main questions for Egypt, who cannot afford to surrender any part of its Blue Nile water and silt to the Sudan under present conditions of great shortage of supplies. The only satisfactory solution that seems to be possible is the provision of greatly increased storage reservoirs at the expense of the Sudan to have works for preventing the loss of silt for both Egypt and the Sudan, combined with strict adherence to limitation of irrigation in the Sudan, with control of supplies in the hands of the Egyptians, safeguards being arranged for to ensure against loss of any part of the share that Egypt is prepared to allow the Sudan. For the present storage of White Nile water, which is siltless at Khartum, will not help in the least and it would be futile to ask Egypt to construct a reservoir for this purpose at her own expense, as was, we believe, at one time seriously suggested to Egypt, even by irrigation engineers not entirely ignorant of the country, rivers and canals!

Kenya-Jubaland Boundary.—When Great Britain ceded her Jubaland possession to Italy, in fulfilment of an agreement made in the Great War, it became necessary to demarcate a boundary between Kenya and Italian Trans-Juba from Abyssinia to the Indian Ocean, a distance of 400 miles. It was decided to construct a 12 feet road as the boundary. The Commission consisted of seven British and three Italians, who commenced work in 1925 and finished in 1927, who had to survey and cut the road through a wild and almost waterless desert, impenetrable forests, gorges and torrents, inhabited mostly by wild beasts and trodden by occasional bodies of wandering Somalis. In the trackless desert the surveyors found and kept their place on the earth by listening to the tick of the master-clock in Paris Observatory. They fixed their points by what is known as "wireless longitude." To get their positions they compared with their chronometers the time

of transit of chosen stars across the web of the theodolite. But where they had to calculate by the 100th part of a second they were faced by the fact that there is an error on the part of the chronometer in Africa in relation to Greenwich meantime. To regulate that error they used their wireless receiving set. The observer put his headphones to each ear. In one earpiece he listened to the half-second ticks of his chronometer, relayed to his ear by wire. In the other earpiece he heard the ticking of the Paris master-clock and waited till the beats synchronised, made his calculations and sent time signals along the 400 miles of survey. The party in its isolation was compensated by being able to listen to concerts and entertainments broadcast from the principal stations of the old world, and every day they intercepted the British official news broadcast from Rugby.

Robot Radio.—Lambeth Hospital, London, is now the possessor of the most wonderful automatic wireless installation in the world; a set which not only switches itself on and off, but chooses the best portions of the programme from 2LO or 5GB each day, thus assuring continuous entertainment for 2,000 patients. The apparatus is installed in a small room, and is only visited once a fortnight for three minutes—the time occupied in winding up the clocks controlling the electrical relays. No other attention is required, and each day the receivers and amplifiers are automatically switched over to the London transmission between 12 and 2 P. M., to 5GB Daventry between 3 and 6 P. M., and then back to London until midnight. In addition, it is possible for the steward to make announcements, relay gramophone records from an electrical gramophone pick-up, and also distribute the Service from the Chapel or the occasional concerts from the main dining hall, to every part of the hospital. This is achieved by a small switchboard near the desk in his private office, 100 yards away from the main amplifiers. An official of the Marconiphone Co., London, stated: "We are proud of this installation, which represents the accumulated experience of several years in hospital wireless practice. As far as we are aware, it has no parallel in the world, and it is easily realised that the absolute simplicity and elimination of battery upkeep is a very great step forward, not only as it relieves the electrician of much work, thus lowering maintenance charges, but also because reliability is greatly increased. There is practically no risk of power failure as duplicate generator sets are fitted, whereas in older battery installations, a moment of forgetfulness may result in the batteries not being charged or the receiver not being switched on, and the patients are then deprived of their entertainment, the value of which is undoubtedly very considerable in assisting the work of healing."

White Nile Upper Waters.—Dr. H. E. Hurst, Director-General of the Physical Department of the Ministry of Public Works, was sent by the Egyptian Government to examine and report on the area of the Great Lakes, where eventually storage works will be required. Two years before he went on the last expedition, which ended early in 1927, Dr. Hurst had already visited the same area and collected information, particularly in connection with the hydrology and climatology of the Upper Nile Basin, and the second expedition was to complete that work by examining the country to the South and West of the Victoria Nyanza, including the sources of the Kagera River, the principal affluent of the Victoria Nyanza. Dr. Hurst went in *viâ* Dar-es-Salaam by train to a little North of Tabora, thence on foot to the South end of the Lake examining the flat country which is swampy in the rains; thence Westward along the watershed and North-Westerly to the junction of the Kagera and Ruvuvu rivers; thence the expedition went into Belgian territory across the mountain country of the province of Ruanda, striking the Kagera again where the Nyavarongo and Akanyaru join it to form the main stream. Dr. Hurst then turned North to the Mufumbiro Mountains, Lake Kivu and Lake Edward. The river Ruchuru and other streams flowing into the South of Lake Edward were examined and then Dr. Hurst turned back to Kabale and on to the Kagera at the eastward bend and so down that river to Bukoba. From Bukoba the expedition went by car to Kampala and Jinja, and thence to Namasagali on the Victor Nile, and returned *viâ* Mombasa. The data collected, it is expected, will give valuable information regarding the régime of the Kagera and consequently of the head waters of the White Nile. The Nile flood comes from Abyssinia, whence comes all the silt used in Egyptian irrigation, but the maintenance of the supply throughout the low period of the year is mainly dependent upon the rainfall of the Lake plateau basin, regarding which Dr. Hurst is now supplying a report.

A Revolution in Tank Design.—The "Matchless" people have been responsible for a decided revolution, or perhaps we should say a distinct evolutionary step in the design of motor-cycle petrol tanks. We refer to the new type of tank with black and white finish which is fitted to six of the 1928 "Matchless" models as shown at the recent Olympia Exhibition. From the constructional point of view the new "Matchless" tank is a great advance on anything which has previously been produced, as, for the first time soldering has been entirely eliminated, every joint and connection being acetylene welded in place. This applies even to the filler cap sockets and to the sockets for the petrol pipe unions. Leakage is thus an absolute impossibility. The tank is formed of heavy gauge steel pressings throughout, which in itself ensures unusual strength. The abolition of solder in the construction of the tank, already mentioned above, has another very great advantage, in that it enables a much better and more durable finish to be obtained. The whole tank is given first a coat of rust-proof enamel followed by two coats of the best quality hard stoving black enamel. Owing to the fact that there is no danger of solder melting the stoving is carried out at a very high temperature exactly as used for frames and other parts, with the result that the black finish is exceptionally brilliant in appearance and very much harder than any finish which can be obtained on a soldered tank. The already famous white panels are produced by the application of three coats of cellulose enamel on top of the black finish; thus, the side panels actually have a depth of six coats. The material used for the white panel is Zofelac Cellulose Enamel, which is standardised for car bodies by some of the largest producers of motor cars in Britain. Zofelac Cellulose Enamel is glass-hard, is practically unscratchable, will not flake or crack, is unaffected by tar, oil or petrol, and withstands rain and mud without ill-effect. If it becomes dirty it can be wiped down with a dry rag or can be washed or cleaned with a petrol rag as may be desired; in fact, washing and cleaning have no deleterious effect on the finish, but only result in improving the gloss.

Current News.

Mr. P. R. Rau has been gazetted a Director of Finance, Railway Board.

It is proposed to put up a petrol refinery near Durban, Natal, at a cost of £750,000.

Major-General A. G. Stevenson has been appointed Engineer-in-Chief with the Army in India.

Major-General Goethals, Chief Engineer concerned with the construction of the Panama Canal, is dead.

Arrangements are being made for the provision of a commercial aerial service between Shanghai, Hangchow and Nanking.

Mr. H. H. Sawyer, the only nominee, has been unanimously elected Vice-President of the Bombay Chamber of Commerce for 1928-29.

The Orki Division of Bikaner Circle, Sutlej Valley Project, has been amalgamated with the Bikaner Main Line Division of the same Circle.

Mr. W. H. Neilson, O. B. E., Chairman, Bombay Port Trust, has been granted leave for eight months and Mr. W. R. S. Sharpe has been appointed to act.

The Council of the Institution of Electrical Engineers has awarded to Professor Fleming the Faraday medal for conspicuous service in the advancement of electrical science.

It has been decided to put up a factory for the manufacture of Ford cars in Yokohama. The output is to be 200 cars a day, and the capital expenditure 1,000,000 dollars.

The total approximate gross earnings of State railways up to 7th January amounted to Rs. 76·85 crores, or Rs. 3,41 lakhs more than the figures for the corresponding period of the previous year.

At a meeting of the newly-formed Commissioners of the Serajgunge Municipality, the Commissioners elected Syed Akbar Ali and Maulavi Abdur Rasid, as Chairman and Vice-Chairman, respectively.

The death has occurred of Admiral Sir Edmond Slade, Vice-Chairman of the Anglo-Persian Oil Company, Ltd. He was Commander-in-Chief in the East Indies from 1909—12 and retired in 1917.

The first underground railway in the East was officially opened on 30th December last. The line runs between the Ueno and Asakusa stations in Tokio, a distance of 3 miles. The construction cost is given as £600,000.

Mr. D. P. Khaitan has been elected President of the Indian Chamber of Commerce, Calcutta, for the current year, and Messrs. Faizullabhai Gangjee and Sheo Kissen Bhatter, Senior Vice-President and Vice-President, respectively.

Mr. A. D. Green, Deputy Chief Commercial Manager of the North-Western Railway, is placed on special duty with the Railway Board in connection with re-investigation of the Agra-Karachi broad-gauge railway connection project.

It is suggested that a new harbour should be constructed at Fortpond Bay, Montauk Point, Long Island, with the object of providing a four-day Transatlantic service. The cost of the necessary breakwaters would be about £1,500,000.

It is reported from Buenos Aires that work will be begun shortly on an extension of the Villa del Rosario-Garza line, a concession having recently been granted with the view of opening up fresh territory and providing better connections.

The total approximate gross earnings of State railways for the week ending 7th January amounted to Rs. 2,16 lakhs, or Rs. 1 lakh less than the figures for the last week but Rs. 7 lakhs more than the figures for the corresponding week of the previous year.

The Samsun-Amassia section of the Samsun-Sivas Railway was officially opend on 21st November last by Behij Bey, Minister of Public Works, in the presence of a delegation of members of the Grand National Assembly of Turkey and of local notabilities.

The question of the apportionment of the cost between the Government, the Port Commissioners and the Improvement Trust for the survey of Garden Reach is pending before the Calcutta Corporation. The Director of Land Records and Surveys submitted an estimate for Rs. 88,839 for the survey of Garden Reach.

The Basirhat Industrial and Agricultural Exhibition was opened at the local Town Hall on Sunday last by Sir R. N. Mookerjee. The Hon'ble Mr. Justice C. C. Ghosh and Mr. Justice B. B. Ghosh, Mr. K. C. De, Member of the Revenue Board, and Mr. J. N. Gupta, Divisional Commissioner, were among those present.

It is understood that the East Indian Railway authorities will open a new line from Tarakeswar to Champadanga in the district of Hooghly. The length of the proposed line is six miles. The work of survey will be undertaken shortly. Another new line between Dinajpore and Ruhea in the Eastern Bengal Railway will be opened in April.

Literary Notices.

Indian Architecture.—According to Mānasāra Silpasāstra. This is the second of the four books on Indian Architecture noticed in last week's issue of this journal. It is a handbook of Indian architecture, sculpture and cognate arts. The author, Dr. Prasanna Kumar Acharya, I. E. S., is an Indian Sanskrit scholar who has been trained in Europe in scientific methods of criticism and who has given the substance of a number of printed works and manuscripts, belonging to libraries in India and Europe which have been visited by him. The book gives an account of the architecture of the Vedic, the Buddhist and the classical periods of India up to the Mohammedan age. An interesting feature is the comparison drawn between the Indian standard work Mānasāra and the European standard work of the Roman architect, Vitruvius. Striking similarities are shown to exist between Greco-Roman and Indian architecture.

Technical Paper No. 257.—This is a "Report on the Handling of Fuel, Lay-out of Engine Changing Stations and other Miscellaneous Developments in the United States of America." By R. C. Case, A. M. I. C. E., Locomotive Department, E. B. Railway. In his Introduction the author states that in accordance with instructions from the Railway Board, he spent August, September and October of 1925 in America for the purpose of investigating the subjects set forth below:—His report is arranged in order of the terms of reference, namely:—Section 1. (*a*) Methods adopted for fueling. (*b*) Conservation of fuel and keeping of consumption statistics. Section 2. (*a*) Lay-outs of engine changing stations. (*b*) Shed-repairing facilities. Section 3. Latest developments in any specific branch of locomotive practice. A general index on page (1) and other references, now in the hands of the Railway Board, merit consultation, particularly with respect to the representative collection of drawings of American and Canadian roundhouse lay-outs. The subjects of this report were studied on thirteen railway systems. If the report is somewhat voluminous it is because of the wide grounds covered by the terms of reference and his desire to deal with the subjects, not in general terms, but in sufficient detail to be of value to the reader. The report is certainly voluminous and is fully illustrated with reproductions of photographs, diagrams and graphs, which render it a really valuable addition to the technical papers hitherto published. The author is to be congratulated on the excellent manner in which he has accomplished his task.

"In the Country of the Blue Nile."—This is the title of a new book, by C. F. Rey, published by Duckworth. Abyssinia and the Abyssinians are being presented to us from almost every point of view. Their art, religion, manners, and customs and the political problems connected with external endeavours to open up the country and develop it with a view to commercial possibilities. With the idea of promoting the welfare of the mountain race, we ought soon to be hearing of the introduction of Western civilization. There will probably be some who believe that these people should not be permitted to practise self-determination and to isolate themselves. They should be coerced if they decline to have the good things that are being offered from all round!

The book has a convenient appendix, containing copies of the notes exchanged by the United Kingdom and Italy regarding Lake Tsana and the proposed railways and of extracts of correspondence relating to the concessions desired by these two countries in Abyssinia, for the good of the people of the country.

Abyssinia belongs to the League of Nations and probably wants to be friendly with all her neighbours, but at the same time would resent interference with her internal affairs. This attitude has been made evident on more than one occasion and it ought to be sympathised with and respected. Those who love the people should wait for invitations before intruding and not ask to be invited where they are not wanted. Abyssinians are certainly not savages requiring to be shown what is good for them by outsiders who have only recently come into touch with them. They also have a very fair conception of the meaning of the expression "mutual advantage" on the lips of many of the candidates for admission to their country in a promiscuous sort of way. Instead of saying "off with you" she politely and tactfully invites them to "come again another day."

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Foreign Notes.

A New Swedish Fuel.—A Swedish engineer, Mr. R. W. Strehlenert, after extensive experimental work, has found a way of extracting a dry substance from the waste sulphite lye of the pulp mills, and combining it with the sawdust and waste products of the sawmills into an industrial fuel of high calorific value. The lye is submitted to an evaporating process, mixed with the wood products and dried. The resulting substance is pressed into briquettes or ground into powder. The briquettes burn slowly, with considerable heat, and will be primarily used as household fuel, while the pulverised matter is to be used as industrial fuel for steam-raising, etc. The powder is said to burn even more easily than pulverised coal, without smoke or waste. The cost of production of the new fuel is said to fall considerably below that of coal.

An Automatic Railway Gate.—Trials made recently by the Swedish Royal Board of Roads and Waterways on a new electrically operated automatic railway-crossing gate which, according to "Commerce Reports," has been installed near Stockholm, have proved so satisfactory that the Board has petitioned the Swedish Government to give its approval. The gate, an invention of a Swedish engineer, Mr. Westfelt, is a simple one-bar, lift-up equipment, the bar being hinged vertically at a pillar which houses the operating motor and supply battery. At a given distance from the gate, on either side, insulation strips are placed between the rail joints, and the rails between the strips form part of the control circuit which is completed by the wheels, engine and cars of an approaching train as soon as the front wheels pass over the insulation. In addition to the control and operating equipment, various visual and aural signals are included for the drivers on both the road and the track. As soon as the train has passed the bars rise again to the vertical position.

Shipbuilding in Russia.—It is stated in a recent issue of the "Bank for Russian Trade Review" that the Leningrad Shipbuilding Trust has received a number of orders from the State Transport organisations for the construction of steamers for the Soviet mercantile marine. The orders have been distributed among the various yards controlled by the Leningrad Shipbuilding Trust. The construction of four vessels for the Black Sea and Baltic Line, each having a deadweight carrying capacity of 4,000 tons, has been begun in the northern yards, and four cargo steamers for the Far Eastern trade have been commenced in the Baltic shipbuilding yards. Work on the construction of three passenger and cargo steamers, intended for the White Sea traffic, will, it is stated, shortly be started at the Marti yards. The building of four timber-carrying steamers, at these same yards, is also under consideration. The ice-breaker "Toros," the construction of which was commenced eleven years ago in Reval, will be completed. It is anticipated that the vessel will be ready for service at the end of this year.

An Arc-welded Bridge.—What is described as the first completed all-welded railroad bridge in the world spans the historic creek on the Turtle Creek-Linhart branch of the Westinghouse Electric and Manufacturing Company's interworks railroad, U. S. A The bridge, which is 62 feet long and contains only 20 tons of steel, is constructed of smooth continuous girders joined by arc welding, and it is claimed that the saving in weight by the absence of riveting amounts to from 25 to 30 tons. Preliminary to the actual raising of the bridge the huge girders were welded in the shops and made all ready to lay. The old bridge was then lifted from its foundations, the new girders placed, all members welded and the tracks laid. These operations were accomplished in one day and a half, four arc welders being employed for the work. The one-piece bridge will be subjected to the most exacting tonnage tests, as it was designed to carry the largest generators built at East Pittsburgh. The bridge was designed and built by the Westinghouse Works Engineering and Maintenance Department.

Blast-furnace Gases.—The electrical purification of blast-furnace gases was the subject of an important conference at the Comité des Forges by M. Ziegel, who gave due acknowledgment to the early experiments carried out by Sir Oliver Lodge, and said that in 1917 an industrial application was made at the Poudreries d'Angoulême. The first application on a large scale was made at the Dilling Steelworks in the Saar, where from 10,000 to 15,000 cubic metres of blast-furnace gas an hour are purified by electricity, with the addition of an automatic cleaning system whereby the dust remaining in the gas is reduced to 8 to 15 milligrammes per cubic metre. A similar installation laid down at the Witkowitz Works in Czecko-Slovakia in July 1926 has given such excellent results that it is being enlarged to deal with 240,000 cubic metres of blast-furnace gas an hour. A plant is under construction at the Homécourt Works of the Forges et Aciéries de la Marine and another at the Mannesmann Works at Duisburg for dealing with 270,000 cubic metres of gas per hour. M. Ziegel stated that while a plant for the electrical purification of blast-furnace gases cost a little more than that for the wet process it was much less than the cost of the dry filtering system, and the working costs were considerably lower.

Hardening and Quenching.—In a lecture entitled "Hardening and Quenching throughout the Ages," given before the Junior Institute of Engineers on 16th December last, Mr. P. J. Haler made many references to early literature indicating the extent of the contemporary knowledge of the hardening of metals. The hardening of weapons appeared to be known at an early date, and the merits of different quenching solutions were mentioned. For instance, Virgil made reference to a glowing sword dipped in the ice-cold River Styx. The superiority of Toledo blades was attributed to some quality of the water of the Tagus used for tempering the steel. A fourteenth-century document mentioned an arrow with steel head "of a blue-green temper that would draw blood out of a weathercock." Coming to recent times, Mr. Haler described the latest method of hardening in electric furnaces. By means of an indicator, the furnace registered the temperature when the metal to be hardened had reached the non-magnetic stage, and at that point it was quenched. The lecturer gave some useful information about quenching based on experiments he had carried out himself. He explained that these experiments were made in order to find out the theoretical basis of present hardening practice. A very high degree of skill had been reached, but that was the result of long practice rather than a study of principles.

Web Stresses in Reinforced Concrete Beams.—Tests carried out in the States with a view to studying the web stresses of reinforced concrete beams under load and to afford information on the amount and distribution of stress in such reinforcements afford data of considerable interest. The 139 beams tested were reinforced in a variety of ways, and particular attention was given to types of reinforcement that would offer resistance to diagonal tension and bond failure. The tests were all made on simple beams subjected to two-point loading, so that in all cases the web reinforcement was placed in a region of constant shear. The results show that through direct measurement of stress in the web reinforcement by means of the strain gauge, a method for which these tests represent one of the earliest applications, it is possible to estimate the web resistance as well as to study the variations in web stress. The action of reinforcement in resisting diagonal tension is not susceptible of exact analysis because of the non-homogeneity of the reinforced concrete member and the high localisation of stress in and around the reinforcing steel. The design of web reinforcement, therefore, is usually made by empirical or semi-rational methods. These methods, although based very largely upon observations on existing structures and upon the results of tests of beams of certain types, cannot be expected to apply with any degree of certainty to new and untried types of members or arrangements of reinforcement.

New System of Railway Carriage Construction.—According to the "Railway Gazette," some corridor coaches, built in accordance with designs prepared by Monsieur L. A. Bréville, Chief Mechanical Engineer of the Northern Railway of France, have recently been placed in service. A noteworthy feature in the construction of these vehicles is the fact of its being based on the girder principle, while the use of wood is eliminated and greatly added resistance to the effects of shock afforded. The new type of coach may be compared to a tubular girder in which the roof contributes to the strength of the carriage, in the same way as the walls and frame. In this system the bottom flooring is represented by the frame, the side girders by the walls, the top flooring by the roof and the tie rods by the transverse partitions, these component parts being strongly interlocked with one another in their assembly. The units forming the sides of the coach are united together by autogenous welding, and at each extremity steel castings are utilised, these being interconnected at their centre portion by a box constructed of pressed steel plate and pressed sections. It is claimed for this construction that a coach has been produced which is equally resistant to the effect of shock, on the lines of a tube, over the whole cross section. The vehicle presents an artistic and pleasing appearance with streamlining effect. Some of the coaches have already been tested in express train service, and it is stated that no noise due to the metallic construction is perceptible, while the stability and smoothness of running are remarkable even when the train is passing over curves and crossings.

Motor Shipbuilding Progress.—Some interesting figures are given in an annual report on the progress of motor shipbuilding, which has been prepared by Mr. A C. Hardy, the editor of "Motorship," New York. At the end of the year 1927 there will be over 700,000 gross tons more ships equipped with marine oil engines under construction than those with marine steam engines Since 1914 the highest powered vessel has increased from 2,600 S H P. to 28,000 S. H. P. for the quadruple-screw Italian liner "Augustus." Analysing the motor vessels of the world on a basis of national distribution, Mr. Hardy finds that, in spite of Great Britain being a coal-producing country, British shipowners now operate no less than 49 per cent. of the total motor tonnage of the world. Of this percentage the group of firms controlled by Lord Kylsant owns nearly 20 per cent., which amounts to about 9·2 per cent. of the world's motor ships, and is only a little less than the 9·6 per cent of Italian owned motor shipping. American owners, if small ships down to 300 tons gross be included, are responsible for about 25 per cent. of the world's total, and if the smaller ships are not taken into account the American quota approaches the Dutch figure 7·6 per cent. Scandinavian owners are responsible for 34 per cent., which figure is second to that of Great Britain. Mr. Hardy further points out that about 71 per cent. of the Scandinavian ships are engaged in tramp work, and he sees in this fact a confirmation of the oft-repeated statement that since the arrival of the motor vessel the tramp steamer is tending to disappear from the seas. It is fair to say, however, that most of the Scandinavian motor ships referred to are employed on long-term charter and are not therefore tramp vessels in the strict sense.

Locomotive Boiler Performance.—As has so often been remarked, the locomotive depends very largely indeed for its efficiency upon the design and working of its boiler, says the "Railway Gazette." In the case of a long non-stop run such as that from London to Carlisle, and *vice versa*, as is done daily on the London Midland and Scottish Railway, the boiler is called upon to meet a wide variety of conditions, and the question of coal consumption in such a case is one of vital importance. On this particular route water is picked up at several points, and the replenishment of the tender is therefore not a matter of concern. The coaling of a locomotive tender for such a run, of course, constitutes a totally different matter, and unless the consumption of fuel is favourable, a much larger and heavier tender would have to be used. Without having any actual figures before us, we should judge, by observation made, that in the case of the "Royal Scot" locomotive, the boiler of which is very well designed, the coal consumption may be set down as between 37 and 40 lb. per mile, which, for a non-stop run of 300 odd miles, would necessitate the carrying of about 5 tons of coal. As a matter of fact, the tenders fitted to this engine have a capacity of 5½ tons, and judging by appearances there is, as a rule, about ½ ton left on arrival at destination, indicating that the figures mentioned are about correct. With this boiler working under the conditions of the particular run, during which an average speed of about 51 m. p. h. is maintained, we should place the water evaporation rate at between 8½ and 9 lb. per lb. of coal burned, and the cylinder horse-power developed at between 1,000 and 1,050 h.-p., or a little higher. In the circumstances, such figures would represent very good performances, and especially as it is known that the locomotive, both as regards its boiler and machinery, makes the run with the heavy trains involved and in unfavourable weather quite comfortably within its powers.

General Articles.

THE AUTOMATIC TELEPHONE IN INDIA.

THE invention of the telephone as a means of transmitting speech between two fixed points over an electric wire is attributed to Dr. Gramham Bell and took place in 1856. The telephone receiver which you hold to your ear every time you use the telephone has been perfected in detail since then but its general principle and even its appearance remain unaltered; the transmission and reception of speech over an electric wire is among the simplest of the problems which have confronted telephone engineers.

For half a century thousands of the best brains in Europe and America have been devising switchboards which will connect together any two telephone instruments out of perhaps a hundred, a thousand or, in the case of London, half a million. The Manual Switchboard, in which the operator connects two numbers together by means of a pair of plugs attached to a flexible wire, is a familiar enough sight in most large offices; to perform this operation automatically various Switchboards have been devised, some operated by electric motors, some by compressed air, some by electro-magnetically controlled mechanical switches and some by electro-magnets alone. The latter are the most widely used in India and are known as "RELAY" Systems

HOW THE EXCHANGE WORKS.

All these four systems have one feature in common, namely, that when a subscriber lifts his receiver from its hook it completes an electrical circuit which energises an electro-magnet (called a "relay") in the Exchange Switchboard.

Figure 1 is a photograph of a Relay in the "idle" position. When current passes through the coil the armature is attracted and moves about 1/32 inch of an inch, pushing up the contacts, which thus complete other circuits. Fig. 2 shows the Relay in its operated position. It will be seen that the Relay is a very simple piece of apparatus which, because of its small movement and the lightness of its moving parts, has no wear and tear. In practice it is found that these relays, once adjusted, seldom if ever require attention. Fig. 3 shows an Automatic Telephone with a dial. The dial is rotated after the receiver has been lifted and rapidly interrupts the circuit a certain number of times, according to the number to be called up, *e. g.*, if the wanted number be 917, the dial would give a series of 9 interruptions, followed by 1 interruption, followed by a series of 7 interruptions.

These interruptions actuate the electro-magnet (or relay) at the Exchange which controls the apparatus which selects the number signalled.

The outward appearance of a small Automatic Exchange of the type now being installed in small up-country stations and in large offices, etc., will be seen from figure 5, which illustrates a complete self-contained automatic unit for 30 lines. The lightning dischargers on which the lines from the street are terminated are mounted on the top of the unit, and these are wired to the relays enclosed within. A number of these 30-line relay units may be coupled together to build up a switchboard of the desired size.

DEVELOPMENT IN INDIA.

The first Automatic Exchange installed in India was at Simla, and the service was opened to the public just before the war. The conversion of manual exchanges to the automatic system was started in earnest by the Indian Telegraph Department in 1922 and at the present time the Department owns 29 Automatic Exchanges, of which 24 are open to the public. Most of these exchanges are of the All-Relay (or non-mechanical) type, these having proved more reliable for use in outlying stations where frequent skilled attention cannot be afforded. Considerable improvements in the reliability of the "Relay" type of exchange have been made during the last two years, the manufacturers having apparently entirely overcome the deleterious effects of the Indian climate.

In addition to the exchanges owned by the Telegraph Department, there are in India seven other automatic public exchanges owned by licensed companies and Indian States and 21 privately-owned automatic systems, serving railways, large offices, etc.

CONVERSION PROGRAMME FOR 1928.

The Telephone Systems scheduled for conversion in 1928 include Patiala City (for public service), the S. I. Railway Company's two private exchanges at Trichinopoly and Golden Rock and five of the G. I. P. Railway's Exchanges in the Bombay area. All these systems will be of the Relay type. The conversion of the G. I. P. Railway's Telephone System to automatic working is of particular interest because of the large area it covers. Fig. 4 shows the locations of the five exchanges along the track between Victoria Terminus and Kalyan and the "junction" lines which connect them to one another. A subscriber has only to dial the wanted number and the automatic apparatus immediately connects him *viâ* an idle "junction" line to the correct exchange and thence to the wanted subscriber; thus a call between, say, a subscriber at Kalyan and one at Byculla is handled as quickly as though both were connected to the same exchange, though actually they are over 31 miles apart, and three exchanges are involved.

ADVANTAGES OF "AUTOMATICS."

"Automatics" are going ahead in India because they save money; there is the obvious saving in having no operator's wages to pay; a second and less obvious saving lies in the lower maintenance costs and lower depreciation, and this saving becomes more and more marked as the equipment grows older, when the cost of keeping a manual exchange working accelerates rapidly.

An interesting case occurred in the Simla hills last year. Applications for Telephone Connections had been made by residents in Sabathu and Dagshai for several years, but the number of prospective subscribers was so small that a manual exchange could not be worked in either of these places without a heavy loss of public money. Last year the Telegraph Department installed a ten-line Automatic Unit in Sabathu and a two ten-line Automatic Units in Dagshai (one in the Bazaar and one in Cantonments). All three exchanges are entirely unattended and provide a 24-hour per day telephone service without financial loss. Such systems as these were of course not practicable until the Automatic Exchange had been brought to such a state of reliability that it could be left for indefinite periods without attention of any description.

From the layman's point of view the chief advantage of the Automatic System lies in its quick operation and the certainty of getting the right number—also secrecy. In this connection the large and growing number of privately-owned automatic systems is significant, since, where the user of a telephone system is also its owner, convenience and efficiency will be considered as well as cost in choosing between the Manual and Automatic Equipment.

Fig. 1.

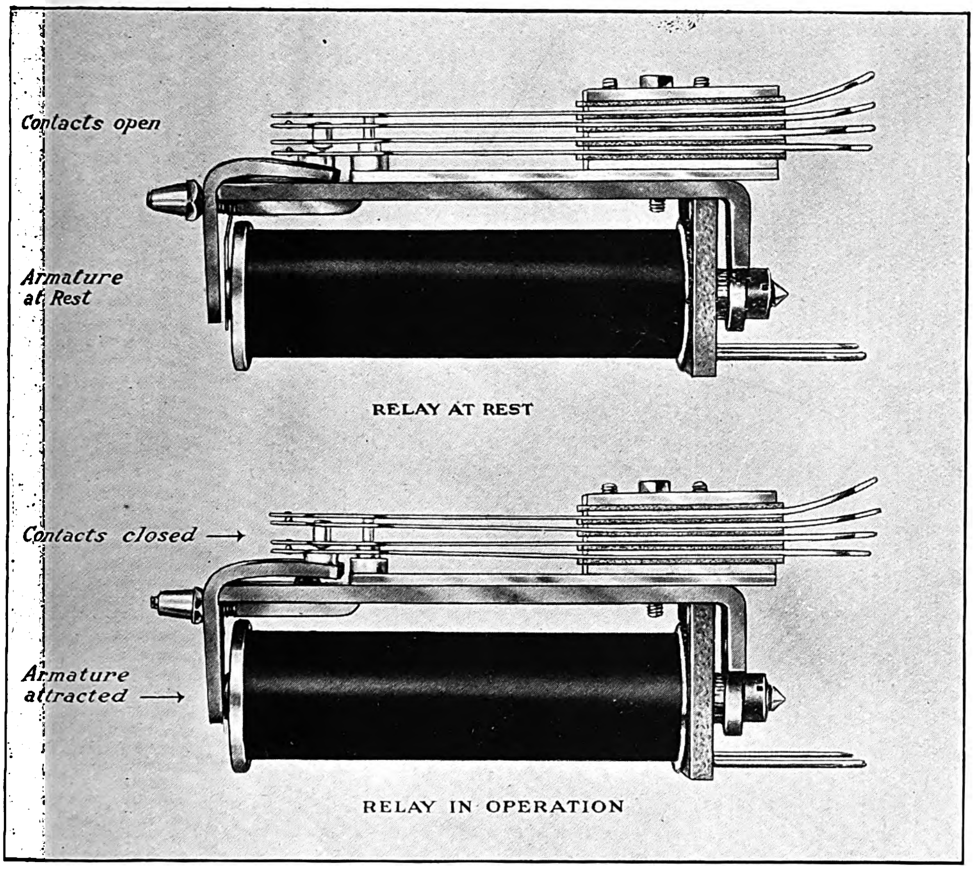


Fig. 2.

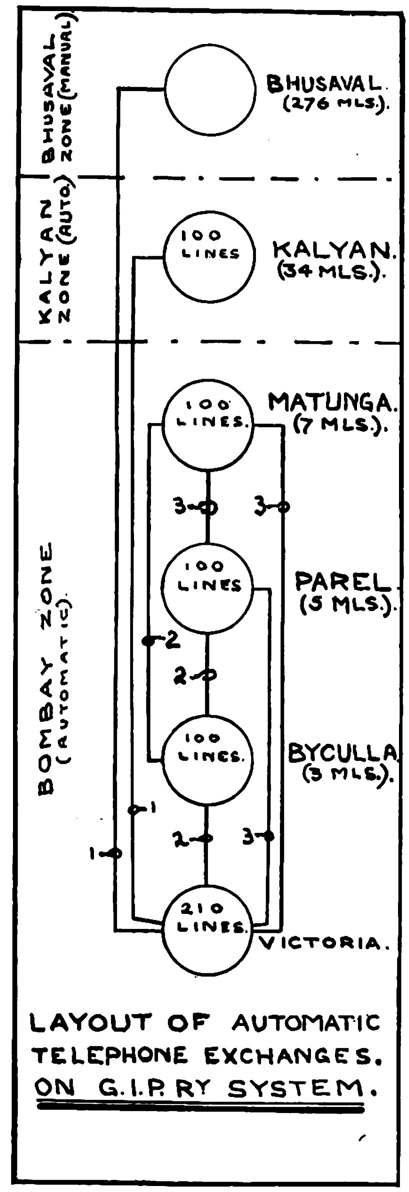


Fig. 4.

Fig. 3.

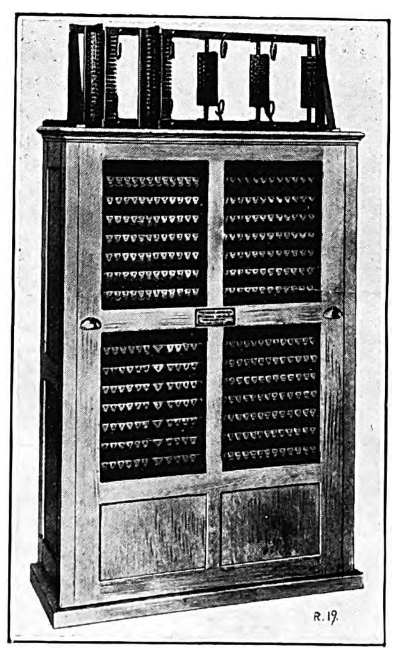


Fig. 5

THE AUTOMATIC TELEPHONE IN INDIA.

SUTLEJ VALLEY PROJECT AND BAHAWALPUR STATE.

THE result of the floating of a sterling loan of £7½ million for India in the London market must be specially gratifying to the Bahawalpur State, who have been protesting against the construction work of the Sutlej Valley project having been kept in arrears of those of the Punjab, for she will now be able to borrow at 4½ per cent. instead of 6 and she has at least half the construction work still left to be carried out. The 1926 revised project estimate showed that the State would have to find about Rs. 11 crores before the work could be completed if the Punjab Irrigation Department continues to insist on keeping the work in its own hands. About half this sum is said to have been expended. If the State were allowed to do its own work in the same way as the Maharaja of Bikaner has been allowed, there would be some savings and there appears to be no reason why she should be prevented from trying to keep down the amount of the borrowings she has been driven into over this project. The Bikaner work is being carried out at very nearly the original cost, if we except the cost of additional work she has embarked on in extension of that originally included in the 1920 project.

Owing to the fall in the price of money it is understood that the State is to be given the full benefit of the change. In this way it will be the partner whose work is most backward that will derive the greatest advantage from sheer sluggishness of progress, while those who have gone ahead will perhaps have to pay more in capital cost and interest. Against this is, of course, delayed realizations by sales of waste land and irrigation receipts for those partners who have been left behind.

It will now be necessary to work out the required financial statements for Bahawalpur State, in the same way as for the Punjab side of the project. An important factor—the most important perhaps—is that connected with the discovery made by the Punjab engineers that, according to accurate discharge measurements of the river, the discharges required for the project do not exist. The irrigation of the project will have to be greatly reduced to arrive at anything like reliable figures for the financial statements and forecast of results.

Before the Council of Regency would agree to join the Punjab in the project in 1920, they asked for and obtained from the Punjab Government a guarantee that the project irrigation would be achieved. The Irrigation Secretary who sponsored the project even stated that they would be "more than achieved." Now that it is admitted that the discharges required for the areas promised do not exist in the river, these irrigation areas and returns from irrigation must be reduced. This places the Government on the horns of a dilemma. The simplest solution appears to be the providing of adequate supplies of water from the shares of the other partners who did not demand any guarantee of the kind that the prudent administration of Bahawalpur insisted on having before she would look at the scheme. Or, and this would have to be at the cost of others than Bahawalpur, the construction of storage works in the hills.

It is said the area of State land sold and the prices obtained, which enter largely into the calculations of returns, have been disappointingly small in Bahawalpur State as compared with the project forecast and with those secured in the Punjab section.

It will be interesting to see the results of the new financial statements when they have been worked out for Bahawalpur State in a companion volume to that for the Punjab in the 1926 revised project. In the case of the Punjab statements, however, the figures will need revision to correct the effects of too high a rate of interest on capital outlay and land sale proceeds having been used and to reduce the expected revenue that will accrue on the reduction of irrigation that must now be accepted as a result of the discovery of the shortage of water supply.

BAHAWALPURI.

THE WATERWAY OF BRIDGES AND CRAIG'S FORMULA.

[FROM A CORRESPONDENT.]

WITH reference to an article on the above noted subject by J. F. in INDIAN ENGINEERING, dated 19th November 1927, pages 292 and 293, I beg to refer your readers to the articles on "Maximum Flood Discharges from Drainage Areas"—pages 226, 227, 240, 241, 242, 267 to 269, 282 and 283 of INDIAN ENGINEERING, dated 14th and 21st April 1923, and 5th and 12th May 1923; also to Mr. Lillie's article IX on pages 96 and 97 of INDIAN ENGINEERING, dated 14th August 1926, which analyse and criticise Craig's formula.

I notice here that Mr. Lillie states on page 97 "It will be noticed that i being the *intensity of rainfall* which produces the maximum rate of discharge must be the maximum intensity of rainfall possible which is the same in all districts dry or wet" whereas Craig in his article (Min. Pro. Instn. C. E., Vol. LXXX, Session 1884-85) states definitely "Quantity of water falling on any small zone FK under a rainfall of i inches $= \frac{B}{2} \times 5280^2 \times \frac{i}{12} \times dy$ (cubic feet)": Craig does not use *i* as a rate of rainfall in inches per hour but as a *depth of rainfall in inches over the whole catchment area.* Craig's maximum flood discharge in cusecs $D = 440 \times C \times i \times B \log_e \frac{8L^2}{B} \times v$: where v = mean velocity of discharge from the basin. He made $N = C\,v\,i$ and then "assumed that $C = 1{\cdot}0$ for maximum flow," *i. e.*, that all water which fell on the catchment area flowed off—there was no loss of any kind! He then made $N = v\,i$, which he called V P (where V = *velocity of approach to point of discharge*), so that the proposed formula may be written $S = 440.\ P.\ B. \log_e \frac{8L^2}{B}$, "the area of the natural and unobstructed flood section under all circumstances.' Please note that v and V are not the same. S is not $\frac{D}{v}$ but $\frac{D}{V}$ since $C\,i\,v = N = V\,P$ when $C = 1$. $V = \frac{i\,v}{P}$, according to Craig! But, this formula was derived from an area the whole of which can be included is an isosceles triangle of length L and base width B, as shown by J. F.

Since $S = 440\ P, \Sigma\ B \log_e \frac{8L^2}{B}$ is Craig's formula, and he says $P = 0{\cdot}18$ for India south of the Himalayas (which has been proved to be quite inaccurate), *i. e.*, it is "a constant depending upon the maximum intensity of the rainfall" whereas P, as shown above, is equal to $\frac{i\,v}{V}$ and i is the *total depth in inches* of rain falling on the catchment area during a great storm. With $P = 0{\cdot}18$ we get $S^* = 184\ \Sigma B \log_{10} \frac{8L^2}{B}$ for an area built of *isosceles triangles.*

Mr. Lillie says "there is an error in the mathematics that results in its not being the logical outcome of the fundamental assumptions, but which, curiously enough, is the cause of the variation, which proves so satisfactory, being arrived at; and the method of application is wrong, and frequently leads to considerable underestimation." †

And now we have J. F. stating "Curiously enough the formula $S = 440\ i.\ B \log_e \frac{8L^2}{B}$ [I notice C is omitted or is considered $= 1{\cdot}0$] can be made to yield a rough and ready idea of the flood area of rivers for

* $80 \times 2{\cdot}3026 = 184$.

† Pro. Instn. of C. E., Vol. CCXVII of 1923-24, page 297.

the use of bridge builders, though it is of no use for calculating flood rates." This value of S applies to an area included in an isosceles triangle. Let us take Craig's original formula $D = 440\ c.\ i.\ v.\ \Sigma\ B \log_e \frac{8L^2}{B}$ cusecs, here v=mean velocity of the drainage off the whole catchment area, and if this is also the mean velocity through the bridge, and C=1 then J. F.'s value of S is correct. But this implies that all water which falls on the catchment runs off and there is no loss of any kind.

J. F. takes A=area of flood section in mile inches

$$S = \text{square feet} = \text{feet} \times \text{feet} \therefore \frac{S}{5280} \times 12 = \frac{\text{feet}}{5280} \times 12$$

$$\text{feet} = \text{mile inches } A = \frac{S}{440} = B\, i \log_e \frac{8L^2}{B}\ ; [C = 1{\cdot}0].$$

J. F. now refers to his figure 1, an isosceles triangle, and shows that $\frac{B \times L}{2}$ = area of triangle = M, or $B = \frac{2M}{L}$, and says "ordinarily $L = 2\sqrt{M}$"—*this is only true of an isosceles triangle when* $B = \frac{L}{2}$, for then $M = \frac{L^2}{4}$ and not otherwise. He substitutes this value of $L = 2\sqrt{M}$, in the equation for an isosceles triangle, $B = \frac{2M}{L}$ (a special case) and gets the value of $B = \sqrt{M}$. He now takes the factor $\left(i \log_e \frac{8L^2}{B}\right)$ and substituting for B its special value $\sqrt{M}$, and for L its special value $2\sqrt{M}$, finds that the factor is equal to $i \log_e (32\sqrt{M})$, which he calls f and so $A = B\, i \log_e \frac{8L^2}{B} = f \times \sqrt{M}$ [this is true only for an isosceles triangle whose base (B) is half of its length (L)].

My calculations give

—	$A = \frac{S}{440}$	$\sqrt{M}$	$f = \frac{A}{\sqrt{M}}$	$\frac{3}{M^{\cdot 07}}$	REMARKS.
Irrawaddy at Prome ...	467	358	1·304	1·3175	Look at the plans of drainage areas given in Mr. Lillie's papers on catchment area discharges in India and see if you can fit them into isosceles triangles with bases equal to half lengths. In no case is $f = \frac{3}{M^{\cdot 07}}$ in this table.
Gunjal on G. I. P....	54	27	2·0	1·8951	
Damodar at Raniganj	125	85	1·47	1·611	
Son at Dehri	309	163	1·9	1·4706	
Sohan at Rawalpindi	23	24	0·96	1·9182	
Kala Nadi in U. P. ...	53	51·57	1·027	1·7271	

LINED CANALS.

PROBABLY the most expensive method of lining canals is to lay concrete on the beds and sides to about one foot higher than the maximum supply level. The method besides is open to risks. To reduce the cost to a minimum, the layer of concrete must be thin, not more than 9 inches thick as a maximum. The layer is subject to settlement and permanent cracking, especially when supplies run low, and the upper portions of the lining are exposed to the sun's rays. It is hardly possible, without slowing down work, to exercise complete supervision. It is difficult to keep the concrete as moist until set solidly as it should be kept; and the dry foundation absorbs much of the water in the newly laid concrete.

The remedy is to seek some material plastic and yielding, to lie without cracking under settlement, and the sun-cracks in which will close at once when again wetted. An ideal material would be good clay, well worked, and mixed with chopped hemp or wheat-straw, and a little cowdung. But in most cases it would be as costly as concrete, though it might be more satisfactory. Another defect is that an error in V_0 might considerably reduce the thickness of the layer by erosion.

It is thought that the chemist must come to the aid of the engineer. It is not impossible, in any locality, to silt a channel dug somewhat wider and deeper than necessary to practically the required dimensions for full supply; and all the chemist would be called upon to do, would be to experiment and to indicate the two necessary cheap chemicals, each of which dissolves in water, but both of which by their chemical affinity combine to form an indissoluble and if possible colloidal and finely divided substance which would be contained in and choke the interstices of the deposited silt.

In a newly-dug canal it might be possible to inject the two solutions into and below the surfaces of beds and banks, to combine in a sub-layer, secure from erosion and never likely to be exposed to injuries. It is merely a question of cost; and this might be much less than expenditure in pumping water from saturated lands, a system, by the way, which can only add to percolation from the canals.

Most engineers are well aware of the difficulties in maintaining percolation in filters of all kinds. The opposite of the problem is presented to their notice.

This article may be regarded as the preface to a series of articles on the Pyramid Kennedy Formula, under the three heads: (*a*) Factorization; (*b*) the Kennedy Formula; and (*c*) the Pyramid Kennedy Formula. The first head is "dogmatic," the second critical, the third gives the proofs.

Σ. Φ.

LAKE TSANA DAM IN ABYSSINIA.

(BY A CORRESPONDENT.)

ACCORDING to Mr. Martin, the representative of Ras Taffari, the question relating to the proposal of the Regent to have the dam constructed at the outfall of Lake Tsana in Abyssinia by an American firm is a simple one. He says that for 25 years now the British Government has been pressing Abyssinia to grant it a concession for constructing a dam at the Lake and a road connecting the Lake and the Sudan, with a view to storing and controlling the waters of the Blue Nile. A perpetual concession is required, but the Negus objects, as this kind of penetration is likely to create political complications in the future. Great Britain has been very insistent of late and Abyssinia, in the face of the pressure, has had recourse to a solution which will avoid the trouble that is feared and still assure the water to Egypt and the Sudan which is said to be the objective of the Government seeking the concession.

The construction of a dam in the very heart of Abyssinia and a connecting road to penetrate right along the Blue Nile to its source, would mean the employment of a large number of British subjects. This would not fail to set up friction and complications between the outsiders and the inhabitants. The introduction of the Capitulatory régime in regard to the intruders would be regarded as a slight on their national dignity, of which Abyssinians are particularly jealous.

Very naturally the Abyssinian Government feared the perpetual character of the proposed concession, which might lead to a desire to exercise perpetual control over the part of their country where the dam and connecting road lay, and in the end it would entail a veritable British occupation of those localities.

The granting of such a concession would bring the Abyssinian Government face to face with the Anglo-Italian agreement of 1925, against which a complaint

had already been made to the League of Nations, and in the end with British help the Italians would insist on their being granted a concession for a railway line right across the country from north to south.

Mr. Martin thinks that the fears of Ras Taffari are reasonable, in view of examples of British policy in such cases. The British Government had advanced the Kenya frontier 20 miles into Abyssinian territory. It has forbidden Abyssinia to sell arms and ammunition and always refuses its support to that country.

In order not to hinder the economic development of the Sudan and Egypt, Abyssinia had turned to a country that had no political ambitions in her territory and one that was rich and competent in such matters as construction and control of dams and reservoirs. No sooner had Ras Taffari come to an agreement in principle with the American White Corporation than there was an outcry that Abyssinia had granted the concession to America behind the back of Great Britain, which was less true than that Great Britain and Italy had been acting secretly in regard to concessions sought in Abyssinia without consulting the latter country in 1925.

It remains to be seen whether Abyssinia will be allowed to take the initiative in the construction of the dam. The allegation that, once having the dam in her possession, she can annoy and squeeze the Sudan and Egypt by cutting off supplies of water, is untrue: she wants to live in peace with her neighbours. Between Abyssinia and the Copts of Egypt there is a close bond of friendship and religion which has existed since the year 1600.

Mr. Martin still thinks there will not be difficulty in arranging that the American syndicate carry out the work of the barrage, providing adequate guarantees for the control and disposal of the waters.

By such a solution interference with the internal affairs of Abyssinia by Great Britain and Italy could be avoided.

Mr. Martin's reasoning appears to be perfectly sound. To it one would like to add that it cannot make any difference to Egypt or the Sudan, who use the Blue Nile water and *silt* as to who builds and controls the dam, except that the preference should naturally be in favour of Abyssinia itself. It is the silt that has totally and always been used by Egypt before the Sennar dam was built, that is required by the irrigators of the Nile and all of it will continue to come down eventually. Storage of this silt it ought to be possible to effect outside of Abyssinia. Lake Tsana collecting ground is a very small fraction of the whole drainage basin of the Blue Nile in Abyssinia.

The mountains of Abyssinia are very cool and most conveniently situated for dwellers of the Sudan to migrate to in the hot season. A Simla enclave with the right to construct and work a road (later on a railway perhaps) from the Sudan to the Tsana Lake, building a dam to store more water in the Lake, a Viceregal Lodge, clubs, bungalows, yachting and all the amenities of a Naini Tal in Africa for the use of the Sudan and Kenya must be the subject of pleasant dreams to the British toilers below. Talking about only wanting to look after the water and silt of the tiny top section of the Blue Nile for the sake of the thousands of years' old irrigation rights of Egypt (partly now being diverted in the Sudan) is not likely to further negotiations with Abyssinia, who appear to have every right to manage their own affairs and cannot be accused of hostility or stupidity if they show distrust of foreign shooting parties, scientific explorers and exploiters from the countries that hem them in from all sides. They are likely to be suspicious of Italy, France and England just at present. If Ras Taffari's proposal to the American Corporation is allowed to go through or the British proposal to have a dam is entirely dropped the former peaceful atmosphere will be restored and no harm will result for anyone concerned.

THE PROGRESS OF AVIATION.

A CURRENT RECORD OF EVENTS.

(BY A SPECIAL CORRESPONDENT.)

LONDON, *29th December 1927.*

THE NEED FOR AIR PROPAGANDA.

SINCE the brilliant success of British aircraft in the Schneider Trophy race, when the winning Supermarine-Napier S. 5 achieved a speed of over 281 m. p. h., the Home Press has contained many allusions to the need for more vigorous air propaganda both at home and overseas. The British aircraft industry is second to none in technical ability and the fact should be brought before the world in no uncertain manner. The solid achievements of British aircraft and engines make stimulating reading, and prove conclusively that for safety and reliability they cannot be beaten.

In an endeavour to develop as fully as possible British Civil and Commercial Aviation and to foster interest in air matters throughout the Empire, the Air League of the British Empire is carrying out very valuable work. It has, unfortunately, a great deal of apathy to contend with, at present, but it is undoubtedly making steady progress. A valuable development in the League's activities is the publication of a monthly journal under the title of "Air," which is sent to all members of the League besides being on sale to the public. This is a well illustrated paper with a number of interesting articles by authorities in the world of Aviation and should, undoubtedly, do much to advance the cause which the League has at heart.

A 23,000 MILES SERVICE FLIGHT.

There are, of course, at the time of writing, several long distance flights in progress by British aircrafts of various types, but perhaps that which captures the popular imagination particularly is the cruise of the four R. A. F. Supermarine-Napier flying boats which are on their way to Australia and the Far East *viâ* India.

This is certainly the most ambitious cruise ever undertaken by any nation, for in all, the boats will cover some 25,000 miles and the cruise is expected to last from 10 to 12 months. It is being carried out as an ordinary R. A. F. service cruise, but it will undoubtedly excite very considerable interest and perform valuable work in "Showing the Flag."

The boats are all metal, built by the Supermarine Aviation Works, and each machine carries a crew of four. The accommodation includes four bunks, and a miniature kitchen with folding tables, lockers and larder.

After flying round Australia the aircraft will return to Singapore where it is expected they will be stationed.

AIR ROUTES FOR AFRICA?

Sir Alan Cobham's projected long flight has been temporarily held up at Malta, where his Short-Rolls-Royce flying boat suffered damage from a rough sea while moored in the harbour, but it is not anticipated that the necessary repairs will delay him long.

Sir Alan's programme is for no less than a 20,000 miles' survey flight round the African continent. He wishes to attract the interest of the African peoples towards the necessity for a through air route across the entire African continent, and to discuss the practical details of such a scheme with the officials of the various governments concerned.

Apart from this aspect, the flight will provide valuable data of the behaviour of this type of flying boat under tropical conditions and afford an opportunity of testing out the engines under variations of climate with landing places at high altitudes.

The Short-Rolls-Royce boat used is driven by two 700 h.-p. "Condor" engines, and is capable of a speed in still air of about 120 m. p. h., with a full load range of 1,000 miles. Its total weight in flying trim is 9 tons, of which 3 tons is a disposable load which can be made up in petrol, oil, passengers and gear.

Sir Alan's route, after leaving Malta will take him to the North Coast of Africa, thence to Luxor and Khartoum from which point he will make due south until he touches the coast again at Laurenco Marques. After that he will follow the coast route *viâ* Durban, Cape Town and Walfish Bay to Lagos; then to Freetown and Mogador and so to Gibraltar.

A COMPLIMENT TO BRITISH ENGINES.

The Far East flight undertaken recently by the Dutch pilot, Lieutenant G. Koppen, was of more than ordinary interest because of the compliment paid to British aero engines by the use of three Armstrong-Siddeley Lynx engines.

Using a Fokker monoplane Lieutenant Koppen set out to demonstrate the rapidity with which mails could be transported by air between Holland and Batavia, Dutch East Indies. The total distance there and back is 19,000 miles and the pilot averaged nearly 1,000 miles per day through all weathers.

The Lynx is, of course, a 7-cylinder radial air-cooled engine of 180 h.-p. and is, practically speaking, one bank of the well known Jaguar.

TWIN-ENGINED FLYING BOATS FOR AUSTRALIA.

The Australian Royal Air Force has just ordered a number of Supermarine-Napier Southampton flying boats, each fitted with two engines developing 1,000 h.-p. These are the first twin-engined boats taken over by this Service and they will be subjected to a very strenuous test on arrival, for they will be flown from Australia to Singapore where they will meet the flight of boats which are flying from England. The combined flight will then proceed to Australia.

The new machines are 5-seater reconnaissance boats, entirely self-contained, in which, during long cruises, the crews live. Sleeping accommodation is provided by slinging hammocks in the hull, and all cooking arrangements can be carried out on board, so that they are independent of their base.

THE PROGRESS OF BRITAIN'S LATEST AIRSHIP.

From time to time curiosity has been aroused by brief references to the giant airship now under construction for the Air Ministry, but it is only quite recently that any details of progress and design have been published.

As a result of some 15 months' work by 300 workmen, R. 100, which is building at Howden, in Yorkshire, is at present a metal skeleton shortly to be covered with fabric. It is anticipated that she will be ready to take the air next spring.

An examination of the giant vessel's dimensions shows that she is comparable in size with an Atlantic liner. Thus, she is 700 feet long and 130 feet high. Dining accommodation will be available for 50 people at a time and 32 beds will be provided in the various cabins. In addition, however, 60 further passengers will be able to find sleeping accommodation in the lounge. The arrangements of kitchens, domestic offices and quarters for the crew are thoroughly complete.

R. 100 is designed to carry 100 passengers and a crew of 35, as well as 10 tons of mails and goods. She will be driven by six 700 h.-p. Rolls-Royce engines giving a total of 4,200 h.-p. Her normal cruising speed will be 75 miles per hour and she will have a range of some 4,500 miles.

It is interesting to recall for a moment the historical journey of R. 34 from England to America and back, the only occasion on which the double flight across the Atlantic has been made and a fine tribute to the reliability of the British built Sunbeam-Coatalen engines.

A NEW HIGH-SPEED ALTITUDE FIGHTER.

Very interesting particulars have just come to hand of a new high performance single-seater fighter manufactured by the Gloster Aircraft Co., and known as the Gloster-Napier Guan.

The fuselage of this machine is of steel tube construction and is covered forward in aluminium cowling and aft with fabric. The design closely resembles the earlier Gloster single-seater biplanes.

A unique feature about the Guan is that it is fitted with a 470 h.-p. super-charged Napier engine. The effects of the super-charger is that the engine maintains its normal horse-power of 470 at 2,000 r. p. m. at high altitudes. Thus, at 15,000 feet, it is said to be capable of a speed of 175 m. p. h.

The fact of machines of this description being able to maintain high speeds at such altitudes opens up an interesting vista of the future of air fighting, particularly as the Gloster-Napier can reach a height of 20,000 feet in 18 minutes only.

The Gazettes.

Bihar and Orissa, January 18, 1928.

Public Works Department.

Babu Kamta Prashad, Assistant Engineer, is granted leave on average pay for six weeks, with effect from 13th December 1927.

Mr. M. A. Dastoor is appointed as temporary Assistant Electrical Engineer, Bihar and Orissa, on probation for one year, with effect from 3rd January 1928.

Punjab, January 20, 1928.

Buildings and Roads Branch.

Lala Diwan Chand Sharma, Apprentice Engineer, under practical training, left the Ferozepore Provincial Division on 18th November 1927, joined the Gurgaon Subdivision of the Gurgaon Provincial Division on 21st November 1927, and took over charge as a temporary measure of the Subdivision on 8th December 1927, from Khan Sahib Mirza Fazal Elahi, Assistant Engineer, retired.

On transfer from the Karnal Subdivision of the Ambala Provincial Division, which he left on 30th November 1927, Lala Brij Mohan Lal, Assistant Executive Engineer, joined the Hissar Subdivision of the Ferozepore Provincial Division on 2nd December 1927, and took over charge of the Subdivision on the 8th idem from Lala Sohan Lal, Najjar, Assistant Engineer, on probation, transferred.

Hydro-Electric Branch.

On transfer from the Punjab, Public Works Department, Irrigation Branch, which he left on 1st December 1927, Mr. W. G. Wheatley, Assistant Executive Engineer, joined and assumed charge of his duties as an attached officer in the "E" (Engineering) Circle of the Hydro-Electric Branch on 8th December 1927.

The Punjab Government (Ministry of Agriculture) is pleased to appoint Mr. S. K. Bawa as an Assistant Engineer in the Punjab, Public Works Department, Hydro-Electric Branch, with effect from 13th December 1927, the date on which he joined and took over charge of his duties, as Subdivisional Officer, "M-P" (Power Plant) Subdivision, from Mr. B. K. Sibou, Assistant Executive Engineer, transferred.

The Punjab Government (Ministry of Agriculture) is pleased to appoint Mr. C. W. J. Purnell as an Assistant Executive Engineer in the Punjab, Public Works Department, Hydro-Electric Branch, with effect from 2nd December 1927, the date on which he joined and took over charge of the "M-C" (Construction Plant) Subdivision from Mr. S. J. Bruford, Executive Engineer.

On transfer from the "M-P" Subdivision of the "M" (Mechanical) Division, which he left on 13th December 1927, Mr. B. K. Sibou, Assistant Engineer, joined and took over charge of the "B-L-M" Subdivision of the "B-L" (Branch Transmission Line) Division on 22nd December 1927 from Mr. K. C. Gandhi, Apprentice Engineer.

On transfer from the "E" (Engineering) Circle, which he left on 12th December 1927, Mr. W. G. Wheatley, Assistant Executive Engineer, joined the "T-h" Subdivision of the "T" (Tunnel) Division on 17th December 1927 and took over charge of the Subdivision on 24th December 1927 from Lieutenant F. E. Pool, R E., Assistant Executive Engineer, who, on relief, was attached to "T" (Tunnel) Division with effect from the same date.

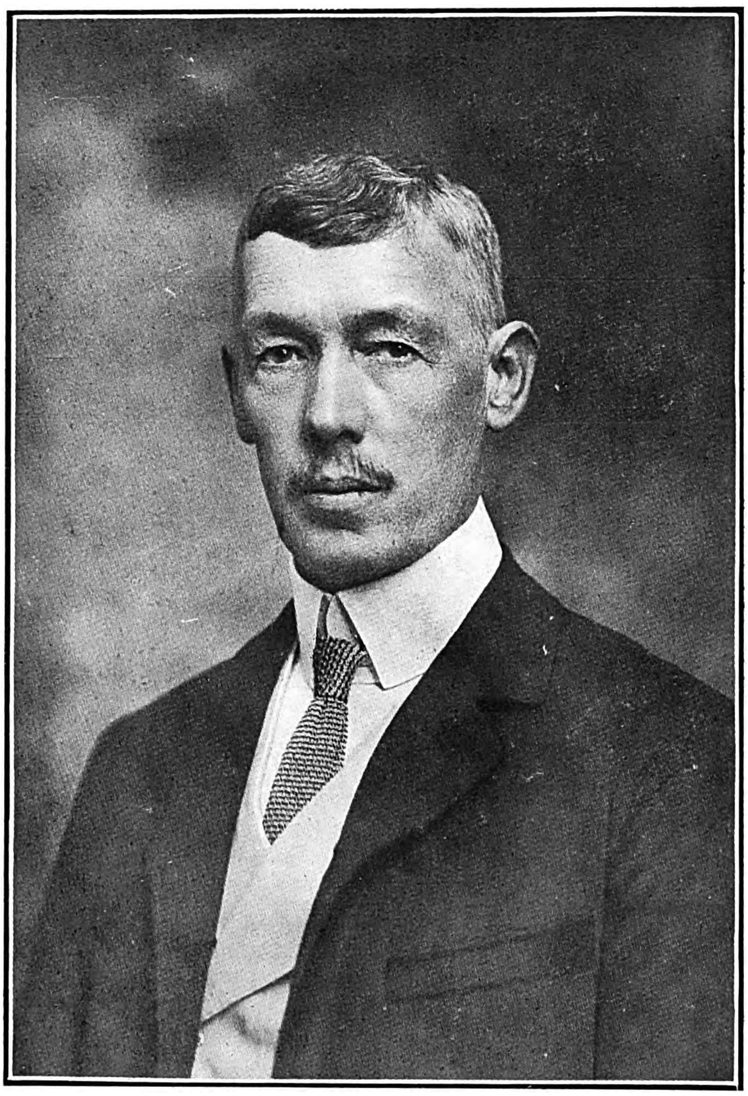
Irrigation Branch.

Lala Parmeshri Dass Sethi, Assistant Engineer, on transfer from the Orki Division, Bikaner Circle, Sutlej Valley Project, which he left on 10th December 1927, joined the Ferozepore Division, Sirhind Canal, on the 17th idem.

Mr. N. H. Charles who has been appointed as Assistant Superintendent, Central Workshops Division, Amritsar, landed at Bombay on 30th December 1927, and joined the Central Workshops Division on 2nd January 1928.

Lala Radha Kishan Gupta, Assistant Executive Engineer, attached to the Islam Division, 3rd British Circle, Sutlej Valley Project, took over charge of that Division on 24th December 1927. from Mr. E. L. Protheroe, Executive Engineer, transferred.

Mr. H. W. King, Superintending Engineer, attached to the Lower Chenab West Circle, is allowed leave on average pay for one day, in extension of the leave granted to him previously.



SIR WILLIAM WILLCOCKS, K. C. M. G.

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INDIAN ENGINEERING.

SATURDAY, FEBRUARY 4, 1928.

SIR WILLIAM WILLCOCKS, K. C. M. G.

I.

THE Thomason College at Roorkhee has in the course of its existence given a goodly number of able engineers to the world, and of them Sir William Willcocks, who made so great a name for himself in Egypt, may fairly be said to be the most distinguished. All the sons of the late Captain W. Willcocks of the Hon. East India Company's Service had certain trenchant traits of character, traits of insistency and self-assertion which gave their personalities—to use a boxing term—a bit of a "punch." And Sir William possessed that temperament in strong degree, with a vivid imagination he combined a practical grip of affairs, he faced his problems with all the courage and confidence of his views, and if he had one of those minds which see visions and dream dreams, he was also that effective stamp of person—"a visionary of action." Lord Dewar once remarked: "The man who wakes up to find himself famous has not been asleep," and Sir William crowded such an immense tale of work into his life that the only wonder is that he had any time to sleep at all.

Sir William Willcocks was born in 1852 in a tent pitched on the bank of an irrigation canal, a not inappropriate beginning for a man destined to live much in tents and in canal surroundings. He was educated at the Mussoorie School, a school run on English public school lines in those days, and Bill, as he was known then, was the head boy of the school. Thence he entered Roorkhee, and passing out the top man of his batch was posted to the Irrigation branch of the P. W. D. in the United Provinces in 1872. As Assistant Engineer he served on the Ganges and Lower Ganges Canals, largely in preparing drainage projects; in 1880, as Executive Engineer, he was employed in the designing and building of protective works at Naini Tal after the great landslip; and in 1881-83 he was on the construction of the Paricha dam on the Betwa river. In 1883, to the misfortune of India, he was transferred to Egypt. It was all the more unfortunate because at that date northern India was showing signs of recovery from the depression into which irrigation had fallen in the eight previous years, and the best engineers were badly wanted in the country to stem the despondency. But in Egypt the need of irrigation engineers was even greater. Irrigation in Egypt had for many years, owing to thoroughly bad administration, been going from bad to worse, and, as was said by Colonel Ross of the conditions of that time, the native talent had sunk so low that without modern scientific aid the Egyptians could not work their own canals. Egypt without the Nile and irrigation from the Nile would be a desert, and the irrigation was in a state of rank disorder. 1883 was therefore a memorable year in that it saw the commencement of

British occupation and the formation of an Irrigation Department under the direction of Sir Colin Scott-Moncrieff, who took immediate steps to import five engineers, Willcocks among them, from India for the work he had in view. How the country responded to the efforts of the new administration is shown by the following figures. At the beginning of the occupation in 1883, the revenue of the country was £9,000,000; at the end of the occupation in 1923, it was £34,000,000. In 1883 the Government was bankrupt; in 1923 there was a treasury reserve of £17,000,000. In the same forty years the population rose from seven to thirteen millions and the value of agricultural land from £150,000,000 to £550,000,000. In 1883 the officials were underpaid and had to live on the fellaheen, the corvée or forced labour was in full swing as it had been for 6,000 years, and the land taxes discriminated in favour of the strong; in 1923 the officials could live on their salaries, the corvée had been abolished, and in the matter of taxes strong and weak were on one footing. Never had the fellaheen of Egypt, nine-tenths of the population, from the days of Menes down to those of the occupation, seen such prosperity and such fair play.

The abolition of the corvée alone was a great fact. Forced labour had always been employed for canal clearances, and especially after the introduction of perennial irrigation the conditions were lamentable. The corvée received no payment; they provided their own tools, carrying wet sloppy earth on their bare backs when their baskets were worn out; they were often knee-deep in slush putting chunks of mud on the backs of others to be carried up the slopes and thrown on the other side, and at every ten metres or so on either bank a man stood and used a cane freely to hasten operations; they brought their own bags of dry bread on which they existed; and they slept on the bare ground without any shelter. The rich never sent a man to the corvée from among their tenants, while high officials not only sent no corvée but made use of the men called out to weed their own private cotton and transplant their rice. The first work that Sir William Willcocks had to supervise as Inspector of one of the Irrigation circles was the silt clearance of a canal by the corvée, and he was struck by the evils of the system. It was evil in every way, it meant cruelty and corruption, and it tended to keep Egypt poor because it was not even economical. The men had to clear canals for others to benefit by and were unable to sow their cotton, and at the best the difficult removal of slush to great depths by such means cost 100 piastres per cubic metre when dredgers could do the work at 5 piastres. But it is always a difficult task to combat old customs and vested interests and, as Sir William said in one of his pamphlets: "When I first proposed the abolition of the physical corvée of the country everybody laughed with good humour at the idea of abolishing an Egyptian institution which was older than the Pyramids." Abolished, however, it was, and by 1889 a hateful form of slavery was swept out of the Nile valley.

In 1889 Sir William reported on the reclamation of Lake Copais in Greece, and was then, as Director-General of Reservoirs, engaged in the preparation of projects for the Aswan and other reservoirs on the Nile and in Lake Mœvis. The great Aswan dam is a work with which the name of Willcocks will always be connected. As first proposed in 1894, it was to have been a dam pierced by 180 openings to allow the muddy waters of the floods to pass through and then store the excess clear water of the winter for use in summer, with a height of water of 34 metres above the zero of the Aswan river gauge, to contain 4,000 millions of cubic metres of water. This was cut down to 22 metres, holding up 1,000 millions of cubic metres in order to save Philæ temple, and Sir William re-designed the work with Mr. F. D. M. Stoney of Stoney Gate fame. The dam was built between 1898 and 1902, and no sooner was it built than Sir William proposed raising it on its own base to 28 metres, storing 2,200 millions of cubic metres, but it was eventually raised to 29 metres on a widened base on the advice of Sir Benjamin Baker. This work, with a storage of 2,500 cubic metres of water, was completed in 1911. Sir William still thinks, however, that the alteration in his original project was a mistake. In years of low supply Egypt has very little water to spare and none to waste on evaporation, and he has shown how the dam could be easily raised to hold up the whole of the 4 milliards of cubic metres he had in the first instance proposed. It would entail the moving of the Philæ temple, but that presents no insuperable difficulties. The temple could be rebuilt on a neighbouring site at a cost of £250,000, a small sum compared to the value of the additional storage capacity to Egypt.

(To be continued.)

INDIAN TARIFF BOARD.

ON the 9th December last, Sir David T. Chadwick, C. S. I., C. I. E., with Sir Campbell Rhodes, C. B. E., who had been a member of the Indian Fiscal Commission, in the chair, read a paper on "The Work of the Indian Tariff Board" before the Indian section of the Royal Society of Arts in London. The 16th February 1923, Sir David said, was a notable day in the life of the first Indian Legislative Assembly, and it was a day which marked a definite event in the economic history of India. It was on that day that the Assembly accepted without a division a proposition that the fiscal policy of the Government of India might legitimately be directed towards fostering the development of industries in India. It was then, for the first time, that India, as a deliberate act, after detailed enquiry and a long debate in the Assembly, adopted protection as an integral part of its fiscal system. The resolution embodied the principal recommendations of the Indian Fiscal Commission, which had been appointed some eighteen months previously to examine the interests concerned. The Commission recommended a "policy of discriminating protection," a policy which in some other countries has since been described as one of "selective" protection. Any industry was then free to apply for protection, but it had to satisfy certain

conditions, that it possessed natural advantages, that without the help of protection it was not likely to develop at all or not so rapidly as was desirable, and that it would eventually be able to face world competition without protection. These conditions left no guidance on a practical point, the rate at which protection should be given, the Commission apparently thought it sufficient to say that where protection was given it must be "adequate but not excessive." A Tariff Board was accordingly appointed in June 1923, and it consisted of Sir George Rainy, Sir Pezonji Ginwala, and Professor Kale. The Board was not a court to receive applications direct, all applications were to be made to the Government, and referred to the Board if it was considered that there was a *prima facie* case. On receipt of the report of the Board, the proposals were to be placed before the Legislative Assembly.

The first case remitted was an application for protection from the rolled-steel industry, and the report, presented in March 1924, covered all rolled steel, bars, rails, plates, galvanised sheets, tinplate, fabricated steel, such as beams and girders, hoops, nails, wire, agricultural requirements, and railway materials, such as steel sleepers, wagons, locomotives, as well as certain items of wrought iron. The conditions of the steel industry at that time were rather chaotic, and they caught the industry in India at an unfortunate moment. The industry applied for a general protective duty of 33⅓ per cent. *ad valorem*, but high as this duty was, Continental prices had fallen so greatly that in October 1924 Continental steel bars were landed in India at Rs. 37 a ton below the figure on which the Board had based its recommendation for a protective duty. The fall in price had in fact wiped out the duty which had been imposed. The Board then advised increased duty, which in some cases would have been 70 per cent. *ad valorem*, but in the meantime the imports brought unexpected revenue, and the Government preferred to give assistance by way of bounty. But the Tariff Board had advised that the scale of duties should be subject to revision after three years, and at the end of the three years there was once more a full enquiry into the steel industry. By that time the position had changed, the Board found that protection was still needed, but the duties could be reduced, and there was no longer necessity for the bounties. They further recommended that the protective duties should be in two parts, a basic duty applicable to any imported steel protected, and an additional duty if the steel were imported from countries other than the United Kingdom. The result was that a basic duty for British-made steel bars was fixed at Rs. 26 a ton, and for foreign steel bars Rs. 37 a ton.

This brief summary shows the procedure adopted in connexion with the steel industry for giving effect to the recommendations of the Fiscal Commission that the policy of protection should be applied with discrimination both in the selection of industries for protection and in the degree of protection afforded. In the case of steel, the industry in India was by the action taken maintained during a difficult period without imposing a heavy burden on the vital interests of the country, such as the railways. In 1912 the total imports of articles of rolled steel just exceeded 1,000,000 tons, of which 444,000 tons were rails. In 1925-26 imports were 950,000 tons, and local production supplied another 320,000 tons. The Tariff Board dealt with many other articles than rolled steel, but Sir David Chadwick illustrated the procedure, taking steel as an example. He did not enter into the merits of the policy or discuss the arguments with which it might be defended or attacked, he merely stated the facts. On the subject of the policy we may have something to say at another time.

ABOUT WEIRS.

To the chapter on weirs in the third and revised edition of Mr. W. G. Bligh's book on "The Practical Design of Irrigation Works," the editor has appended some interesting notes; and the weir subject is one to which Mr. Woods in the course of his service in India has devoted a good deal of study. He commences with what he calls "the lessons of the Narora weir" of the Lower Ganges Canal. In the winter of 1875-76, the foundations of this weir were laid and built up to about floor-level, and the crest-wall was founded on a line of masonry wells sunk to 10 feet below floor level. The floods of 1876 were allowed to pass over these foundations and at the end of the season it was discovered that a subsidence had occurred where the line crossed the deep channel of the river. No steps had been taken to afford any extra protection at this weak point by sinking the foundations deeper or by other means. The only safeguard adopted was the laying of an apron of puddled clay, covered by a 3 feet depth of loose kankar blocks, along the whole length of the weir on the upstream side. Construction was completed in 1878, and nothing particular appears to have happened till the engineer in charge began to manipulate the shutters on the crest of the weir with a view to scouring away the sand-banks, or islands, upstream. This was done throughout the floods of 1895-96-97, causing scour parallel to the weir, and in 1898 the weir failed at the place where it crossed the former deep channel of the river. The local engineer in aiming at scouring away the islands had scoured away the upstream apron, the only protection the work had at its weak spot, weak because at this place the wells were not sunk into the soil and merely rested on the bed of the deep channel, or on sand filling of no stability. Mr. Woods therefore concludes that the damage to the Narora weir of 1898 was due to bad original design and construction, to undesirable manipulation of the shutters and to neglect of the maintenance of the apron; and inasmuch as the damages of 1876 and 1898 occurred at the same place, his conclusions, read in the light of the full explanations his note contains, appear to be correct.

The Khanki weir across the Chenab river is next discussed. It was built for the purposes of the Lower Chenab Canal in 1890-92, and in two places in the bed of the river were channels which had been main channels. Mr. Woods contends that the weir should have been built of special strength where these former deep channels were crossed; but, as in the case of the Narora weir, no such action was taken, and in 1893 and 1895 failures of the structure took place at these sites. The matter is of some importance because the editor's notes have a bearing on the text of the book. Mr. Bligh in his chapter on the subject had dwelt on a theory of design based on certain principles which had for some time previously received much recognition in northern India. Every irrigation engineer in the United Provinces and the Panjab of about that time must have heard a superabundance of talk on the question of hydrostatic uplift or "blow-up," more particularly perhaps on the part of the late Mr. J. S. Beresford who, once he was attracted by some such engineering consideration, had a way of galloping it to death. That does not of course mean that the question of hydrostatic uplift is unimportant or to be neglected; but in the case of the Narora weir failure it led to some irrelevant arguments, and Mr. Woods has done useful work in showing that the two series of accidents at Narora and Khanki were not due to hydrostatic uplift, but to an opposite cause, the withdrawal of hydrostatic support. He explains that it was not a case of "piping" caused by excess of gradient through sand, and that there must have been cavities under the masonry, due to foundation sand slipping into the deep scours upstream of the weirs; or, in other words, that the damages in all the instances cited were not attributable to "blow-up," but were due solely to upstream erosion undermining the structure in places where the masonry was founded on a shifting bed of sand. Further, at Khanki, as well as at Narora, he holds that faulty working of the shutters, practised with the object of scouring away sand banks, must also bear a share of the blame. On the latter point, it is well known that at times of low or falling river discharge, sand islands are liable to be thrown up by the action of the separate streams of water, and that these islands, if not disturbed, become grass-grown and consolidate themselves into obstacles to the evenly-distributed flow over a weir. Executive engineers in charge of canal headworks were therefore encouraged by their superior officers to scour away islands masking the weir approaches, and their action by shutter manipulation sometimes did more harm than good.

Mr. Woods is against weir-shutters, and calls them "a device dating from the 'dull dark days' of irrigation canal science in India." Movable shutters on the crests of weirs in Northern India were first adopted in the case of the weir for the Sirhind Canal at Rupar, and they were thought at that time to be so valuable an innovation that the same feature was introduced at the heads of the Lower Ganges, Lower Chenab and Lower Jhelum Canals. There was some reason for the belief, the great perennial rivers vary greatly in discharge, they may carry high floods or little more than a trickle or anything in between, and always there is a silt question. It was held that a high-level weir meant interference with the normal regime of rivers, it meant afflux and possible danger, and a greater severity of action on the weir talus. Shutters enabled floods to pass over a low weir with a minimum of objection and also enabled water to be held up for feeding canals when rivers were carrying low supplies. They afforded in addition means of sweeping away the silt deposited upstream of the weir. Engineers, even engineers of reputation, therefore attached great value to the device. To Mr. Woods the system was wrong in principle, the shutters were troublesome to work and required a large establishment of workmen to manage them in the flood season from May to October, and he was of opinion that they were wholly or partially responsible for most of the accidents that had occurred at various times at Narora, Khanki, Rupar and Rasul. In his note, he quotes the view of the Superintending Engineer of the Godaveri Delta Canals, expressed fifty years ago: "I have disallowed the so-called self-acting shutters. These I consider utterly useless on our canals, carrying so much silt in the irrigating season. It is certain that those we have are worse than useless; in theory nothing can be more perfect; in practice, nothing less so.' The conditions of the deltaic rivers of Madras are not exactly those of the rivers of the Panjab and the United Provinces, but Mr. Woods was opposed to the falling-shutter device, requiring thirty or forty men to manipulate it in addition to other objections, and he had the courage of his opinions.

As Chief Engineer in the Panjab, he removed the shutters of the Rasul weir, and raised the masonry crest by 3·7 feet, or to a level just sufficient to give the necessary command over the canal, and carried out other alterations to the headworks to prevent the passage from the river to the canal of water-borne sediment in excess of the carrying-on capacity of the canal current. At Khanki, he applied the same principles, fitting the sluices with "Stoney" gates, remodelling the regulator, and raising the weir, though in this instance he adhered to the shutters. He retained the shutters here because he apparently feared that to raise the weir crest still further might lead to swamping of the cultivation on the low-lying lands upstream. In these two examples, he carried radical changes into effect in spite of some adverse opinion, but the point is that they were carried out and the Panjab has since had ample time to appraise the results. If the Lower Jhelum Canal has worked satisfactorily with a shutterless weir, it should be evident that a source of trouble and expense has been eliminated, in addition to avoiding the risk of faulty shutter-working, and the Panjab Irrigation owes a debt to him. From his recent notes in the new edition of Bligh, he himself has the same opinions as he had when he made the changes at Rasul, and if he is wrong there have been opportunities for showing in what respects he failed. His notes on the subject are in any case well worth perusal.

Notes and Comments.

Sarda Canal Progress.—A resolution of the United Provinces Government on the administration of the Public Works Department during the year 1926-27 describes the construction of the Sarda Canal as most satisfactory throughout its length. An expenditure of Rs. 1,27,04,807 was incurred on this work.

New Greek Loan.—The Greek Loan floated under the auspices of the League of Nations was issued for £3,370,960 in London. £600,000 in Italy and Sweden and $17,000,000 bonds in New York and Zurich. The London issue was quickly over-subscribed. A later New York message states that the American portion of the Greek loan has also been over-subscribed.

Sukkur Barrage.—The contract for the 66 sluice gates of this barrage has been placed by the India Office with Messrs. Ransomes and Napier, Limited, of Norwich. The gates, which are 60 feet wide and 18½ feet deep, will be fixed to each of the 66 spans of the barrage, each gate weighing about 40 tons. They will be manufactured throughout with British materials and British labour.

Banks and Cotton Industry.—Presiding at the annual meeting of Martins Bank at Liverpool, Mr. Holland Martin said that the suggestion that Banks should come to the assistance of the cotton industry and take control by investing in debentures and shares was impracticable and entirely against the traditions of English banking. Banks were still prepared to make such advances as were deemed safe, but reorganisation of the industry must come from within.

New Concrete Publication.—"Concrete : Blocks, Slabs and Bricks," is the title of the latest pamphlet issued by the Concrete Association of India. This little brochure deals exhaustively with the subject of making blocks, slabs and bricks, and is profusely illustrated with diagrams and photographs. All those interested in the manufacture of these three articles in concrete, can obtain copies of this booklet gratis by writing to the Secretary, The Concrete Association of India, Home Street, Bombay.

Eastern Bengal Railway.—At a meeting of the Calcutta Advisory Committee of this Railway, Mr. N. Pearce, the Agent, presiding, referred to the construction of a railway line from Habra to Satkhira *viâ* Baduria. He informed the Committee that owing to the decision of the Government of Bengal to drop the project of the Trunk Canal the outlook of railway development in the neighbourhood of Satkhira had been altered and that the views of the Railway had not been formulated but that the project would be considered in turn with other projects.

Assam-Bengal Railway Co.—The Governor-in-Council, Burma, has by a notification under Section 4 of the Land Acquisition Act authorized the Engineers of this Railway to survey land and do all other acts required in connection with the work of construction of a metre gauge line between Chittagong and Dohazari, a distance of about 25 miles. The general route to be taken for the survey will be from Chittagong to Dohazari, through Solosohar Sankar Hat, Gomdandi, Shirarpol, Potiya and Kanchanagar. This line will form the nucleus of the proposed Indo-Burma Railway line connecting Chittagong with Burma.

Sale of Sutlej Valley Lands.—The next auction of Crown waste land in the Nili Bar Colony will be held at Pakpattan on 6th, 7th and 8th March 1928. About 10,000 acres of land, including some large plots, will be sold, probably in the following Chaks :—(i) 39/E. B. on 1L Distributary, near Arafwala ; (ii) 209, 219, 221, 223, 231/E. B. on 3L Distributary, near Fitna ; (iii) 471 and 473/E. B. on 5L Distributary, near Burewala. Plans and schedules are under preparation and will be available on application to Mr. F. B. Wace, Colonization Officer, Montgomery, about three weeks before the date of sale.

U. S. Cotton Crop.—Reviewing the cotton outlook in 1928, the Department of Agriculture declares that growers will probably meet the relatively favourable condition of a smaller carry-over than last year, and that the demand situation will be about the same as for the last crop. The most uncertain factor is the size of the crop. The department sounds a warning against an increase in acreage, recalling that low prices were the result of over-planting in 1926. As regards culture, it says that much will depend on the abundance of boll-weevils which are more numerous and have greater vitality than for several years. It is not yet known how far they have succumbed to the low temperatures experienced in the cotton belt.

R. A. F. Flying-boats.—The flying-boats which are on a 25,000 miles cruise to Australia arrived at Nawabganj on the Hooghly, from Lake Chilka, on the 27th January last. It was a spectacle worth seeing when they flew over Calcutta and was witnessed by great crowds. The four boats are in charge of Captain Cave-Browne-Cave, whose pilot is Flight-Lieutenant H. G. Sawyer, A. F. C. No. 1 carries Squadron-leader G. E. Livcock, D. F. C. (Second in Command), and Flight-Lieutenant P. E. Maitland, A. F. C. No. 2 machine is piloted by Flight-Lieutenant D. V. Carnegie, A. F. C., who had with him Flying Officer G. E. Nicholetts. The Royal Air Force dinner was held at the Bengal Club on the 1st instant. All the officers of the R. A. F. Flight to the East were present.

Abyssinian Outrage.—In June last, it may be remembered, a caravan taking supplies to the camp of Sir Geoffery Archer, the Governor of the Sudan, who was on a hunting expedition in Abyssinia, was attacked by Abyssinian soldiers and had eight of its Somalis killed and ten wounded. With Sir Geoffery was the Maharao of Kutch, who had been the guest of the Regent at Addis Ababa and he had been told the route the caravan was to follow. The Court of Arbitration appointed to enquire into the matter placed the responsibility on the Abyssinian Government, and awarded the British Government £3,000 damages and directed the removal from the post near the British frontier of the Chief of Jigjiga, who commanded the party that attacked the caravan.

Enquiry Committee for Sukkur Barrage.—For the Bombay Legislative Council session to commence on 20th February, a number of resolutions have been tabled calling for the appointment of a committee to enquire into the scheme. It seems strange that the Bombay Government has continued to resist all proposals for an independent enquiry into the Sukkur Barrage project during all these years, for there must be some

good reasons for the persistent demand, which started in 1920 when the scheme was first prepared. Its contemporaries of the Back Bay and the Sarda were enquired into after similar resistance, and it was found that there was ample justification for the public outcry. After the Sukkur Barrage project the Sutlej Valley project would form a good subject for treatment.

Ridding Bengal of Malaria.—Several projects have been put forward to this end, but the most remarkable views bearing on this problem have been expressed by Sir William Willcocks, the celebrated engineer, who is now on a visit to this country. His plan is to rid the country of malaria by leguminous fodder crops raised by irrigation. He has a theory that a mosquito living near scented clover is rendered incapable of carrying disease. His view is that there is no possibility of ridding Bengal of malaria except by irrigation. He purposes going over the delta of the Ganges to see how Central Bengal could be irrigated by perennial irrigation. He is of opinion that there is a scope for erecting a barrage on the Ganges to irrigate Central Bengal which was favourably situated for perennial irrigation.

Chiniot Railway Bridge.—Tenders have been called for in lump sum for the construction of the railway bridge at Chiniot over the Chenab river. This is the third large railway bridge for which lump sum tenders have been invited, the other two being for one over the Indus at Kalabagh and another over the Jhelum river at Khushab. The contracts for the two latter have been placed and work is being started. The intention is to bridge the Ravi river next opposite Okara and to utilise the Suleimanke weir over the Sutlej river for carrying the through broad gauge railway line from Kalabagh to Bhatinda. It seems probable that the conversion of the Kalabagh-Bannu line from narrow to broad gauge will follow in due course, thus giving a direct second railway from the frontier to Delhi.

Back Bay Case.—In delivering judgment in the Harvey-Nariman case, otherwise known as the Back Bay libel suit, Mr. Dastur, Third Presidency Magistrate, held that while Mr. Nariman had failed to prove justification in making his allegations against Mr. Harvey, Superintending Engineer of the Development Directorate, personally he had produced ample evidence to prove that he had acted in good faith. He had shown, and the complainant himself had admitted, that there were ugly rumours in the city that corruption was rife among the officers of the Department. The defendant, Mr. Nariman, in conjunction with Mr. Trivedi, had collected sufficient material to convince them that officers were in the habit of receiving secret commissions. The Magistrate held that the accused had acted in good faith before a competent authority, and acquitted him. The cost incurred by Government in this case is stated to be over Rs. 50,000.

Punjab Canals in December 1927.—The report for December shows that on the Southern Administration Canals slight rain fell in canal irrigated areas. The demand for canal water was keen to moderate, but the river supplies were insufficient. With the exception of a few light showers of rain the weather in the Northern Administration Canals area was cold and dry. The river supplies were exceptionally low and the consequent shortage in canals has been felt considerably in certain districts. The supplies available have been used to the best advantage and the condition of the crops is fair on the whole. Consequent on the early cessation of the monsoon and the subsequent scarcity of rain, a decided improvement is apparent in water-logged tracts. Satisfactory progress is reported on extension works on the Lower Chenab Canal. Drains and other anti-waterlogging works in hand in the Upper Jhelum, Lower Jhelum and Upper Chenab Canal areas have made good progress.

Kidderpore Docks Strike.—As the result of the cessation of work by more than 700 men of the Port Commissioners' shunting and gate staff at Kidderpore Docks, a serious situation had arisen, and all bookings to Calcutta by the Eastern Bengal, Bengal-Nagpur and East Indian Railways were temporarily suspended. The loading of coal and general cargo steamers was affected, but concerted measures were taken for the working of locomotives by an emergency staff. The position has arisen following the submission of a petition referring to promises made in 1920 to the men regarding scales of pay, the supply of uniforms and holiday allowances. It was alleged that these promises had not been kept. No demand was made for any general increase in pay, but three days later a second petition was presented in which a general increase in pay was demanded. At the time of going to press we learn there has been a marked improvement in the strike situation. A considerable number of the men returned to work on Wednesday last and a number of others have indicated their willingness to resume work.

Jodhpur's Railway Interests.—"We have invested in the railway a sum of over four crores of rupees. I confidently hope that, whenever projects of the nature of the Karachi-Cawnpore connection, likely to affect adversely the interests of my railway, are being re-examined in the light of changing circumstances, the case of my railway will receive adequate and sympathetic consideration." (Speech of H. H. the Maharaja of Jodhpur at banquet to Their Excellencies Lord and Lady Irwin.) Lord Irwin sympathised with His Highness' anxiety lest the railway system which had been built up with such foresight and energy should be adversely affected by the construction of a broad gauge connection between Karachi and Agra. This important scheme was now again to be examined. Much would, of course, depend on the alignment eventually selected. Should the project materialise His Highness might rest assured that every endeavour would be made to reconcile the conflicting interests and to evolve a scheme which would provide the facilities demanded by a growing port like Karachi, without neglecting the rights of the existing railway systems.

Messrs. Rendel, Palmer and Tritton.—This distinguished firm, whose services and advice have been at the disposal of the Indian Government for the last 50 years, have agreed to co-operate in making a substantial advance towards the complete adoption of the rupee purchase system. The firm is well known as having great practical experience of structural and mechanical engineering work and requirements in India as well as other countries. The firm has agreed to set up a branch in this country and to give professional advice on conditions which represented a payment by the Government which was estimated to be the annual cost of running a branch office, without any provision for additional remuneration by way of fees to the partners of the firm over what they already receive in respect of their office in London. The arrangement is to be for three years, a period which will

suffice for the establishment of the new policy of the rupee purchase of stores. This branch will be associated with the Indian Stores Department. Their services will be directly available to all railway administrations and other Central Government Departments and minor local administrations.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 19th January 1928:—Messrs. Martin and Co., Calcutta—2 Rail Tractors, paraffin, 20 h.-p., 4-ton, four wheels coupled, complete with spares for two years' normal working, Rs. 11,448 free delivery at Panaghar Head station by 8th April 1928; 62 Joists, R. S., Rs. 1,173 f. o. r. Howrah; Messrs. Jessop and Co., Ltd., Calcutta—3 Switchboards, for the power station plant at Campbellpore, Rs. 2,190 free delivery at Campbellpore in 16 weeks; 2 Engines, steam, single cylinder, portable, 24 b. h. p., 155 r. p. m., fitted with extra large firebox for burning coal or wood fuel, Rs. 8,524 free delivery at Panaghar Weir Division, one engine *ex* stock and one in nine weeks from 13th January 1928; 2 Mortar Mills, 7 feet, overdriven fixed type with cast iron pans with renewable bottom plates, cast iron gearing and roller type bearing, fitted with fast pulley, Rs. 3,320 free delivery at Panaghar Weir Division *ex* stock; Messrs. Parry's Engineering Ltd., Calcutta—104·71 cwts., approximately, Rails, F. F. 30 lb., with fish-plates and fish-bolts and nuts, Rs. 1,102 free delivery Rawalpindi.

Railway Development Schemes.—Four of the most important of these were sanctioned by the Railway Standing Finance Committee on the 28th January. The most important one, costing Rs. 1,20,00,000, is the construction of a Lyallpur-Chananwala cross-connection by the North Western Railway. This will cut across the parallel lines which at present serve the Lyallpur-Jhang colony districts and the Sutlej Valley irrigation projects, thereby linking up existing six lines in the colony area. The Great Indian Peninsula Railway will construct a Kartal-Atarra-Kamasin Branch at a cost of Rs. 40,00,000 and also a line between Khamgaon and Chikli at a cost of Rs. 36,00,000. Sanction has also been given to the construction of a Senchoa-Nairabar Railway in Assam, which will cost Rs. 21,00,000 and will, it is expected, prove very remunerative. The Railway Budget for 1928-29 was considered and approved. Among other proposals sanctioned are the proposed electrification of the Madras suburban section of the South Indian Railway at an estimated cost of Rs. 37,00,000, the remodelling of Erode junction station costing Rs. 81,00,000 and the revision of the superior traffic cadre of the Burma Railway costing Rs. 40,000 per annum. A traffic survey by the East Indian Railway for a line from Shahjahanpur to Milani, a distance of about 40 miles, was also sanctioned.

Watt and Steam.—Professor Edward Andrade, in lecturing on "Learning about Steam," made some very pertinent remarks, but what he said about James Watt was especially interesting. It is often thought that Watt invented the steam-engine, and that the idea came to him by watching a kettle of water on the boil. But thirty years before Watt was born, Savery had constructed a steam-engine, which was actually used for pumping. The inspiration came to Watt when he was given a model of a steam-engine to repair. He saw the defects of the model and sought to improve the design of it. He invented the separate condenser which greatly increased power at less cost of working and every economical engine of the present time reflects the Watt system. If Watt did not invent the steam-engine, the Professor said, he added immensely to the knowledge concerning it. He converted it from a crude and unreliable contrivance, used only for pumping water out of mines, into a highly efficient machine, using less than a quarter of the coal consumed by anything that had gone before. It was because of the economies he effected that England rose as a manufacturing country to be without a rival in the world. The Professor said that nearly every feature of the modern reciprocating engine is to be found in Watt's later designs. Watt's governor, with the rotating balls, finds a place on engines of all kinds from the gas engine to the gramophone motor. The finger of Watt governs the speed and smooth playing of the gramophone record. So that if James Watt did not invent the steam-engine, his inventive genius was of infinite value in giving an impetus to the original invention. The engine that came to his hand sucked up the water into a vessel by condensation of steam, and then drove the water from the vessel to the surface by steam pressure. It was a clumsy way of utilising steam, and it was Watt's separate condenser that made all the difference, and Watt remains on the high pedestal he occupied before.

Success of a Lady-Architect.—Of recent times women have invaded several of the professions which used to be exclusively the province of men. Architecture is one of them, there are quite a number of lady-architects now, and it has often been said that in the matter of domestic architecture the women have certain special qualifications. The clients of an architect are always liable to be women, and when there is a woman client she is more than likely to be meticulous regarding the details of a house in which she is going to live. That being so, a lady-architect, being a woman and therefore able to understand the wants of her own sex better than a man, has advantages in being able more readily to grasp a woman's ideas as to what constitutes good and satisfactory interior arrangements in domestic architecture. But now there is a case of a woman's success in an open competition of quite another kind. The competition was for the design of a new Shakespeare Memorial Theatre at Stratford-upon-Avon, where Shakespeare was born, to replace the old theatre which was burned down in 1926. The design then was for a theatre, and for an important and very special kind of theatre, worthy of its aim to perpetuate Shakespeare's memory. It is to be a theatre for producing Shakespeare's plays, and where people interested in Shakespeare can meet for purpose of discussions. The building is moreover required to suit the conditions of the site on the bank of the river Avon, a picturesque situation in suggestive surroundings. The design had to be beautiful, it had to be appropriate, twelve months were given for the competition, it was not confined to British architects, and seventy-two designs were sent in. The assessors were eminent men, and unanimously they selected the design of Miss Elizabeth Scott, who is twenty-nine years of age and completed her professional training only three years ago. Young as the winning competitor is, she has the blood of architects in her veins. She is the grand-niece of both Sir Gilbert Scott and George Bodley, great ecclesiastical architects in their day, and second cousin to Sir Giles Scott who designed the beautiful Liverpool Cathedral. Miss Scott is to be congratulated on a very notable achievement.

Current News.

OVER 170 miles of all-concrete road were laid in Great Britain and Ireland during 1927.

A GRAIN elevator is to be erected at New Westminster, British Columbia, at a cost of 700,000 dollars.

IT is estimated by the Mississippi River Commission that its scheme of flood control will cost 684,000,000 dollars.

IT is proposed to raise a fund of £2,000,000 dollars in Ontario for the purposes of organising industrial research work.

MR. H. A. F. LINDSAY, C. I. E., I. C. S., Trade Commissioner for India, has proceeded on six months' leave. Mr. Eyre Gordon (Central Provinces) will probably relieve him.

IT is expected that the foundation stone of the new Bengal Council Chamber will be officially laid by His Excellency the Governor of Bengal about the middle of March.

SIR GEORGE GODFREY has been elected representative of the Bengal Chamber of Commerce in the Council of State, in the place of Sir John Bell, who resigned his seat about a month ago.

BEFORE the Road Development Committee, Mr. Holman-Hunt, Chief Engineer, Buildings and Roads Branch, P. W. D., Burma, said there was a desire in the province to link Burma with India by railway.

THE total approximate gross earnings of State Railways up to 14th January 1928 amounted to Rs. 79·14 crores, or Rs. 362 lakhs more than the figures for the corresponding period of the previous year.

THE Government of Burma, P. W. D., Irrigation Branch, have sanctioned the formation of a temporary subdivision in the Salin Canal Division to be known as the "No. 2 Construction Subdivision," with headquarters at Linzin.

IN connection with the scheme of railway development, undertaken by the North Western Railway, a new line, known as the Lyallpur-Chak Jhumbra-Chiniot Railway, was opened on 28th January by His Excellency the Governor of the Punjab.

THE Government of Burma, P. W. D., Irrigation Branch, have sanctioned the formation of a temporary subdivision in the Kyaukse Construction Division, to be known as the "Temporary Survey Subdivision," with headquarters at Kyaukse.

IT is understood that the Khyber Railway has been temporarily closed for repairs. The character of these repairs is not definitely known, but it is said that the trouble is due to the blocking of the line owing to the subsidence of either a tunnel or a cutting.

THE total approximate gross earnings of State Railways for the week ending 14th January 1928 amounted to Rs. 219 lakhs, Rs. 3 lakhs more than the figures for the last week, and Rs. 11 lakhs more than the figures for the corresponding week of the previous year.

AT the end of last year the total installation of water power plants in Canada was 4,883,000 horse-power, and if the present rate of increase continues will easily have passed the 5,000,000 mark by the end of 1928. The capital expenditure on the plant is estimated at 900,000,000 dollars.

IT is stated that a scheme for a new deep-water dock for the Tees, to provide berthing facilities for large ocean-going liners, is under consideration by the London and North Eastern Railway and the Tees Conservency Commission. It is stated the project may involve an outlay of £2,000,000.

THE Railway Board have sanctioned the construction by the Agency of the Eastern Bengal Railway Administration of a line of railway on the 5 feet 6-inch gauge from Kalukhali station to Bhateapara with a branch from Madhukali to Kamarkhali, a distance of about 53 miles. The project will be known as the Kalukhali-Bhateapara Railway.

THE construction of the new central passenger terminus of the Canadian National Railways, at Montreal, will probably be started in the spring of 1929, Three years will be required to complete the terminus although it is likely that partial completion will permit of some trains entering the station from the south toward the end of 1930.

APPARATUS has been devised by Monsieur James Basset of Paris, with which he can attain pressures as high as 150 tons to the square inch. The compressor he employs is of the two-stage type. In the first stage a liquid is compressed to a pressure of 6 tons to the square inch, and this liquid is then used to actuate the piston of the second stage.

IT is reported from Tokyo that in the spring it is proposed to commence the construction of a line 18 miles in length to bring the city of Tsitsihar, capital of the Province of Heilungkiang, into direct communication with the south. The project is of interest, as this will be the first Chinese railway to cross the Russian Chinese Eastern Railway's right-of-way.

THE Railway Board have sanctioned a reconnaissance survey being carried out by the Agency of the Eastern Bengal Railway Administration for a line of railway to connect the eastern end of the extension of the Bengal Duars Railway with the southern end of the Cooch Behar section of the Eastern Bengal Railway near Gitaldah, a distance of about 50 miles. The survey will be known as the Eastern Bengal Railway and Bengal Duars Railway alternative connection survey.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

LINING OF THE GANG CANAL.

SIR,—I am obliged to T. B. for the very interesting information given in his letter in your issue dated the 17th December 1927.

The *traditional* method of dealing with comparatively thin layers of lime and soorkhee concrete (as in terraced roofs) in Northern India, is: (a) To lay the concrete quite a wet mixture, and in depths up to about six inches, and (b) To consolidate it with *thappees*, employing women and boys if possible, to ensure lightness of touch. The concrete never to be allowed to dry till set, and then to be covered with a layer of *wet* earth, allowed to remain and be washed off naturally in the coming S. W. monsoon. The next season would see a thick skin of coarse plastering added, to take alternations of heat, wet, and cold, and do the cracking.

At any rate, verbiage apart as regards details, that was, in general terms, the procedure as confided to me in my Apprentice Engineership by an ancient *raj mistree*, the descendant from Moghul days of a long line of *raj mistrees*. When I began myself to use cement instead of lime, I discovered almost at once the grave danger of permitting it to dry out too soon. As regards ramming concrete, I have had *one* experience with old and well-rammed material which made my hair stand on end!

The road rammers I referred to weighed 10 lb. each, and were circular in flat base and 5 inches in diameter. Ordinarily, they were lifted and dropped from 6 inches to 9 inches; but under supervision, the lift and fall was from 12 inches to 15 inches. The kankar I used was very good (*vide* Government Report on the Budaon District when I held charge), but nevertheless it suffered, as stated. T. B. will be able to compare the comparative force of the blows on the road, and the blows in lining the Gang Canal.

The great difficulty on the above work was lack of water. Would T. B. please criticise the following method :—

In a trapezoidal section let A B be the waterline of full supply, and C D the bed of canal. Completing the earthwork to take the lining, lay on C D a two-inch coat of mud or (if no earth is available) weak lime plaster, let it dry out, fill any cracks, and carry it up both slopes from C and D about two feet. On this plastering lay the concrete it is intended to use, bone dry, mixed dry *without any water*. Then cover at once with any available dry earth or sand to about 6 or 8 inches depth, sloped up at banks not to slip when wetted.

When all is ready, let water trickle down the canal just deep enough to percolate and set the concrete. This would have to be done very gradually and cautiously, not to permit too rapid percolation. Finally, with the water supply at hand, complete the concrete on the two slopes in the usual manner.

Σ. Φ.

Literary Notices.

The Reactivity of Coke.—Standardised Method for the Determination of Comparative Values. By J. H. Jones, Ph. D., A. I. C., J. G. King, Ph. D., A. R. T. C., F. I. C., and F. S. Sinnatt, M. B. E., M. Sc., F. I. C., London. Published under the authority of His Majesty's Stationery Office. 1927.

The Fuel Research Technical Papers form a series of special papers and reports on the results of work carried out at H. M. Fuel Research Station or elsewhere. This paper (Technical Paper No. 18 of the Department of Scientific and Industrial Research) deals with an investigation into the reactivity of coke which is in progress at the Fuel Research Station and describes an apparatus designed to measure the amount of carbon dioxide reduced when the gas is passed over heated coke under standardised conditions, and gives some of the results so far obtained with the apparatus. The numerical values obtained for the "reactivity" of the different cokes tried by this method are comparable among themselves, but refer only to the precise conditions which have been standardised in the apparatus used. The investigation has been carried out in co-operation with the Fuel Economy Committee of the National Federation of Iron and Steel Manufacturers who have contributed to the cost of the work. The methods to be investigated and the results obtained have been discussed from time to time with Mr. E. C. Evans, the Fuel Officer to the Federation. It has been possible, in a preliminary way, to show some co-relation between the reactivity values obtained, the physical properties of some of the metallurgical cokes and their behaviour in the blast furnace, but much more work is required before any explanation can be given as to the real meaning of the observations. The investigation is proceeding, and a further report will be published when sufficient progress has been made.

INDIAN PATENT RIGHTS.

NOTICE is hereby given that the Proprietors of Indian Patent No. 5678, dated 28th May 1920, for "**Railway Car Coupling,**" being desirous of exploiting the same in this Country, are prepared to grant Licenses for the working thereof in British India on reasonable terms. Full particulars may be had on application to—

REMFRY & SON,
PATENT AND TRADE-MARK ATTORNEYS,
21, Old Court House Street
Calcutta.

Foreign Notes.

Large Milling Machine for Russia.—What is claimed to be the largest milling machine in the world has been built for Russia by a German firm, the Schiess-Defries A.-G. in Dusseldorf. The total weight of the machine, including the universal boring and milling equipment, is given as 500 metric tons. The two main standards give a clear opening of 4·5 m. (say about 15 feet). The total length of the machine is 28 m. (say about 93 feet) and the travelling frame can be fixed in any position between two points 24 m. (say 80 feet) apart.

German Locomotives for South Africa.—The Railway Administration of the Union of South Africa has accepted German tenders for the supply of 90 locomotives, costing £560,213. Firms in Great Britain, the United States, and Italy were among the tenderers, but the contract was divided between six German firms after giving the fullest consideration to the various proposals submitted and also taking into account the various conditions governing the respective tenders, quality of material, and workmanship. The British prices were about 25 per cent. above the Germans.

Water Falls for Brazil.—At least 1,100 water falls of varying size have been reported for all Brazil, and rough surveys of them have resulted in an estimated capacity of 2,500,000 h.-p. The rainfall is fairly uniform, so that streams maintain a reasonably constant flow, and the construction of storage ponds is not difficult. The State of Rio Grande do Sul is planning the erection of an 80,000 h.-p. station on the Jacuhy River, in order to supply light, heat and power to Porto Alegre and the neighbouring towns. This plan has been retarded because of unsettled political conditions, but is now receiving serious consideration.

A Magnetic Nail Collector.—A New York correspondent of "The Times Trade and Engineering Supplement" describes a method which has been developed in the United States for collecting nails and other metal articles upon roads, which are a prolific source of tire punctures. It involves the use of a magnetic nail picker. The magnets, which are the essential part of the device, are in 4-foot sections, one, two or three sections being used according to the width and roughness of the road to be treated. The magnet is a wire-wound bar laid in one side of an I beam, the open side being covered with a brass protecting plate. The I beam sections are suspended just in front of the rear wheels of a two or three-ton truck, and are thus taken over the road. The truck carries a 3-k.w., 110-volt, d. c. generator, driven by a Ford engine, to energise the magnets.

Bridge Across the Sautet Gorge.—The new bridge across the Sautet Gorge of the Drac River, in the French Alps, is to be a single reinforced concrete arch of 283 feet span, 525 feet above the bottom. The centering at such a height was a difficult problem, but it was solved by the engineer, Monsieur Caquot. The solution was to span the gorge with a three-hinged arch of wood construction, each half to be erected in a vertical position at either side and then rotated about the lower ends as pivots until the outer ends would meet in the middle, these two half-arches to be so shaped that, when in position, the upper chord would coincide with the curve of the intrados of the concrete arch, and thus act as a base for the forms. The construction of one of the abutments was completed not long ago, and very recently the placing of this unusual centering was successfully completed. The actual lowering of the two halves into position was accomplished in forty-five minutes.

Control of Water-Softening Plant.—At a recent meeting of the London Section of the Society of Chemical Industry, a paper was presented by Dr. H. S. Hatfield on "The Automatic Analysis of Liquids and its Applications to the Control of Water-Softening Plants." An apparatus was described by which measured samples of the water or other liquid are drawn, and a reagent added to them until the desired change—such as from alkalinity to neutrality—is effected. Thereupon the proportion of reagent used is automatically shown on a chart, in terms of alkalinity or other property of the liquid from which the sample was drawn. The chart record consequently shows the changes from time to time in the degree of hardness, alkalinity, or the like, of the water works product, or effluent which is under test; and control may thus be readily maintained of the softening or other treatment to which it is being subjected. A further development of the mechanism makes the apparatus itself control, according to its indications, the valve by which the reagent—such as the softening chemical—is delivered to the bulk of the liquid, and thereby affords complete automatic regulation of the process.

The Rand Water Board.—The quantity of water available at the sources of supply of the Rand Water Board, Transvaal, South Africa, was increased during the past year by the completion, at the end of August 1926, of the works necessary to deliver a second instalment of five million gallons of filtered water a day, from the Vaal River, to the Board's Zwartkopje's pumping station in the Klip River valley, about 11 miles south of Johannesburg. The total supply available from all sources averaged 16·95 million gallons a day, during the five months ending August 1926, and 20·95 million gallons a day during the succeeding seven months. According to the annual report of the Rand Water Board, for the year ending 31st March 1927, the rainfall during the summer months of that period was scanty and irregular. The fact, however, that the Board had, at its disposal, a reliable supply of water from the Vaal river, enabled it to meet the high demands made upon its resources. The sale of water, during the year under review, averaged 13·69 million gallons a day, representing an increase of 1·09 million gallons over the highest average daily quantity previously recorded. The daily consumption varied between a maximum of 17·73 million gallons (18th October 1926) and a minimum of 9·06 million gallons (11th July 1926).

A New Rail-Joint.—According to the "Railway Gazette" a new type of rail-joint, designed to take up the wave motion of passing loads, and also to resist lateral motion, is now being introduced on several American railways, after some years of successful experimental service on the St. Louis South Western Railway. A distinctive feature of this joint, which is the invention of Mr. H. F. Roach, is that it gives contact surfaces only 4¼ inches long between the splice bars and the head and base of the rails, the end portions of the bar being tapered at top and bottom so as to be clear of the rail. Further, the bars are bent or sprung longitudinally, so that while the middle portion is free from the rail web, the ends are in contact with it, and are held against it by the bolts. The bars are only 22½ inches long, with four bolts, and are of the plain or fish-plate type, without angle or flange. With the short contact surfaces the rail ends are free to deflect in the wave motion set up by passing loads, but both rail ends must deflect uniformly. The action is to some extent that of a hinge joint. No vertical load is transmitted through the ends of the bars, since they are free from the rails, and the bolts are consequently relieved from stresses ordinarily sustained. In fact, it is claimed that the joint acts mainly in shear, with only a small bending moment.

Shanghai Public Works Department.—Among the more important works carried out, during 1926, by the Public Works Department of the Shanghai Municipal Council were the reconstruction, in concrete, of Chapoo Road Bridge, which was opened to traffic on 1st December 1926, the widening of a number of roads, the construction of 12 sewage pumping stations, and the laying of over five miles of sewers, varying in size from 6 inches to 3 feet diameter. The annual report for 1926, of the Commissioner of Public Works, Shanghai, gives an indication of the multifarious nature of the duties carried out by departmental officers under his control. In addition to the construction and care of bridges, public buildings, roads, drains, sewers, and landing accommodation, a great deal of work in connection with surveying, dredging, quarrying, boiler and lift inspection, and concrete-ware manufacture is carried out. The Department also has its own workshops containing a full complement of machine tools, and, during the year, some 7,600 operations were completed. The Department now possesses 78 motor vehicles and 22 road rollers, and the maintenance of these vehicles constitutes a large item. Shanghai has a number of parks and open spaces, which are also controlled by the Department; these are laid out and administered on most modern lines.

High-Capacity Railway Trucks in Victoria.—The Victorian Railway Commissioners report that, in the United States, the use of large trucks have made possible substantial freight rate reductions. The Commissioners point out that the cost of freight on the shipment of the Victorian wheat harvest to Liverpool is about £730,000 more than the cost of shipping the same quantity of wheat from an average United States centre would be, and that a considerable portion of this amount is accounted for by the higher Australian rail rates from the producing area to the seaboard. These higher rail rates were in great part due to using trucks of low capacity. As the business of the railways expanded, the carrying capacity of new vehicles was increased until, towards the end of 1924, there was, roughly, an equal number of 11-ton and 16-ton capacity trucks. The tare weight of the 16-ton trucks was less than a ton greater than that of the 11-ton trucks. When both kinds of truck are now loaded to their full capacity, there is a distinct advantage from a carrier's point of view in that the 16 ton truck gives about five tons more paying load for less than a ton difference in dead weight hauled—an economic factor that is not only reflected in the paying load for each truck, but also in the paying load per train. In a train of 400 tons, for example, there are 25 tons more non-paying load in the case of a train made up of small-capacity vehicles than in a train composed of larger-capacity vehicles.

Walschaerts Gear and British Railways.—The "Railway Gazette" states that until comparatively recently the Walschaerts valve gear for locomotives did not find general application in this country; indeed, it is even now regarded as one of the later developments of locomotive practice for purely British locomotives. It is, therefore, of interest to note that what appears to have been the first English locomotive to have this gear fitted was a 0—4—4 type side tank engine designed by the Fairlie Engine Company, of London, and built in 1878 by The Avonside Engine Company, of Bristol. This engine, or a similar one, was placed in service in 1881 on the Swindon, Marlborough and Andover Railway, and the late Mr. E. L. Ahrons, in his work "The British Steam Railway Locomotive, 1825—1925," records that its chief historical claim was that of its being the first locomotive on any British railway with Walschaerts valve gear. Unfortunately, the shed foreman was not provided with any diagram or instructions, and the firm which had built the engine had then changed hands. It was sent in January 1882 to the works of another railway where the Walschaerts gear was also completely strange. The engine consumed more than 40 lb of coal per mile on light passenger trains of about six small carriages, and as a consequence spent most of its time in a siding. The Walschaerts gear did not reappear on a British railway until many years later, when it was introduced on the Belfast and Northern Counties Railway. All the private locomotive building firms had, however, long constructed engines fitted with this gear for overseas railways.

Thames Bridges.—According to the "Engineer" while the report of the engineers on the Charing Cross Bridge scheme is being awaited, the Bridge House Estates Committee has been examining another of the schemes favoured by the Royal Commission on Cross-River Traffic, namely, the construction of a new bridge at Ludgate. It has adopted a report submitted by a sub-committee in which the Ludgate Bridge scheme is compared with the St. Paul's Bridge scheme and is found wanting. The St. Paul's Bridge scheme has been long in existence and considerable sums, principally by way of the purchase of property on the route of the bridge approaches, have already been expended in connection with it. If the scheme is now abandoned in favour of the Commission's Ludgate Bridge there will be a substantial loss of money. In addition, the sub-committee argues that the Ludgate Bridge scheme has been hastily conceived, is unsuitable in its route, and impossible to carry out at anything like the cost indicated in the Commission's report. As regards St. Paul's Cathedral, the sub-committee holds that neither scheme would endanger the fabric by vibration or by the construction of the piers. The route proposed for the Ludgate Bridge scheme would be further away from the cathedral than that planned for the St. Paul's Bridge, but the northern abutment of both bridges would be practically at the same distance from the nearest point of the cathedral. The Court of Common Council of the City of London is to be asked to authorise the Bridge House Estates Committee to consider and report on the whole question of cross-river traffic within the City area.

General Articles.

COMPRESSION AND BEAM TESTS ON CONCRETE MADE OF BROKEN BRICK, DISTRIBUTARY SILT, AND CEMENT, AND ITS COMPARISON WITH STONE CEMENT CONCRETE.

By R. A. BRADSHAW-SMITH, Professor, Civil Engineering, Thomason College, Roorkee.

IN the plains of India stone and good building sand are not always easily obtainable more especially in the Doabs through which the main canal systems are aligned. These tests have been carried out with a view to the substitution of distributary silt and broken brick, for the coarse sand and broken stone usually specified. The experiments have been carried out in the Thomason College Laboratories at Roorkee, the main objects being to obtain constants for the usual R. C. formulæ applicable to the new conditions.

Silt.—The distributary silt used was obtained from the Mahommedpur left Main Distributary, Ganges Canal. It contained a fair number of mica grains and a little reh effloresced on the briquettes made.

The residue on a 20 × 20 to the square inch sieve was *nil* except for a few mica grains. The residue on a 76 × 76 to the square inch sieve was 4 per cent. only.

The sand with which it is compared was after washing and screening a well graded sharp building sand obtained from the Ranipur Rao. The sand showed the following residue :—

20 × 20 sieve residue was 6 per cent.
30 × 30 „ „ „ 12½ „
76 × 76 „ „ „ 81 „

The cement used was from one of the Associated Portland Cement Company's Factories at Gillingham in England.

Briquette Tests.—As a preliminary the strengths of various proportions of cement with the silt and sand were compared after 7 and after 28 days. The figures tabulated are the mean breaking stresses of from 3 to 6 briquettes in lb. per square inch.

Proportions.	Cement with silt.		Cement with sand.	
——	7 days.	28 days.	7 days.	28 days.
1 Cement 2 s.	170	292	242	388
1 Cement 3 s.	69	136	118	240
1 Cement 4 s.	45	113	65	155

Brick.—The brick was ordinary well burnt brick graded from ¾ inch to ½ inch, with pila picked out. Tests were also made of clinker which gave practically the same results.

Compression and Beam Tests.—The original specimens were made up of 1 : 2 : 4 concrete in the Standard moulds 13 inches high by 6 inches diameter, and were tested to obtain the modulus in compression in a 50-ton Buckton Testing Machine.

The results *vide* diagram No. 1 were fairly consistent showing a gradually increasing modulus with age.

Beams in this mixture were also broken in comparison with beams made of ordinary reinforced stone concrete and coarse sand of identical design. The comparison is, of course, unfair, as the brick-ballast beams crushed in compression before the steel was fully stressed. The stone concrete ones being designed as balanced beams the brick-ballast beams were necessarily not so.

	Beams. D×B	Span.	Proportions.	Steel reinforcement.	Concentrated load Failure at.	Time setting.
Brick Ballast	8½″×4″	8′	1 : 2 : 4	3 No. ⅜″ bars	1·4 tons	7 weeks.
and Silt.	„	8′	1 : 2 : 4	„	1·4 tons.	7 weeks.
	„	8′	1 : 2 : 4	„	1·7 tons.	7 weeks.
Stone	8½″×4″	8′	1 : 2 : 4	3 No. ⅜″ bars	2·3 tons	7 weeks.
Concrete	8½″×4″	8′	1 : 2 : 4	„	2·3 tons	7 weeks.

showing a factor of safety of 3 for the Brick Ballast Beams and 4·6 for the ordinary R. C. Beams, which were designed to carry ½ ton.

It was found that the 1 : 2 : 4 concrete is an unsuitable proportion for broken brick concrete. A lot of soorkhi breaks from the brick increasing the wet mortar content at the expense of the aggregate, so the resultant mixture consists of a cement mortar with brick plums.

A more suitable mixture was found by experiment to be 1 1½ 5½ and a comparison of the diagram shows that it does not lose in modulus value or in ultimate strength.

Ten specimens were tested but only a few have been plotted to avoid confusion on the diagram (No. 2). The results are very consistent attributable to the careful truing up of the specimens.

The mean modulus for 1 1½ 5½ brick ballast concrete after one month may be taken for the purposes of design as 250,000 (*vide* diagram 2), *i. e.*, the ratio Es to Ec is 120 as against the generally accepted figure of 15 for stone concrete.

The mean ultimate crushing stress after 28 days works out to 710 lb. per square inch (the minimum of all specimens broken being 553 lb. per square inch).

The following crushing stresses of ordinary stone concrete have been previously observed in the college :—

Proportions.	Date of manufacture.	Time.	Breaking stress.
1 : 2 : 4	24th February 1922	31 days	1,866 lb. per sq. inch.
	„ „ „	„	1,630 „ „ „
	„ „ „	„	1,679 „ „ „
	„ „ „	„	1,704 „ „ „
	„ „ „	„	1,368 „ „ „
	25th March „	„	1,740 „ „ „
	14th July „	„	1,718 „ „ „
	22nd February „	„	1,550 „ „ „
	„ „ „	„	1,659 „ „ „
	„ „ „	„	1,557 „ „ „
	„ „ „	„	1,990 „ „ „

The mean crushing stress after 31 days is 1,678 lb. per square inch. After six months, however, the mean ultimate crushing stress rises to 2,488 lb. per square inch.

The crushing stress in R. C. calculations is usually based on 650 lb. per square inch which accordingly gives a factor of safety of 2·5 after one month and 4 after six months.

Applying a similar factor to B. B. concrete we get a safe crushing stress of 284 lb. per square inch after one month or, say, 250 lb. per square inch in round figures. And using Taylor and Thompson's notation we get the following constants :—

Brick ballast concrete.	n	steel fs	fc	k	j	p	c
1 : 1½ : 5	120	16,000	250	·652	·781	·00509	0·118

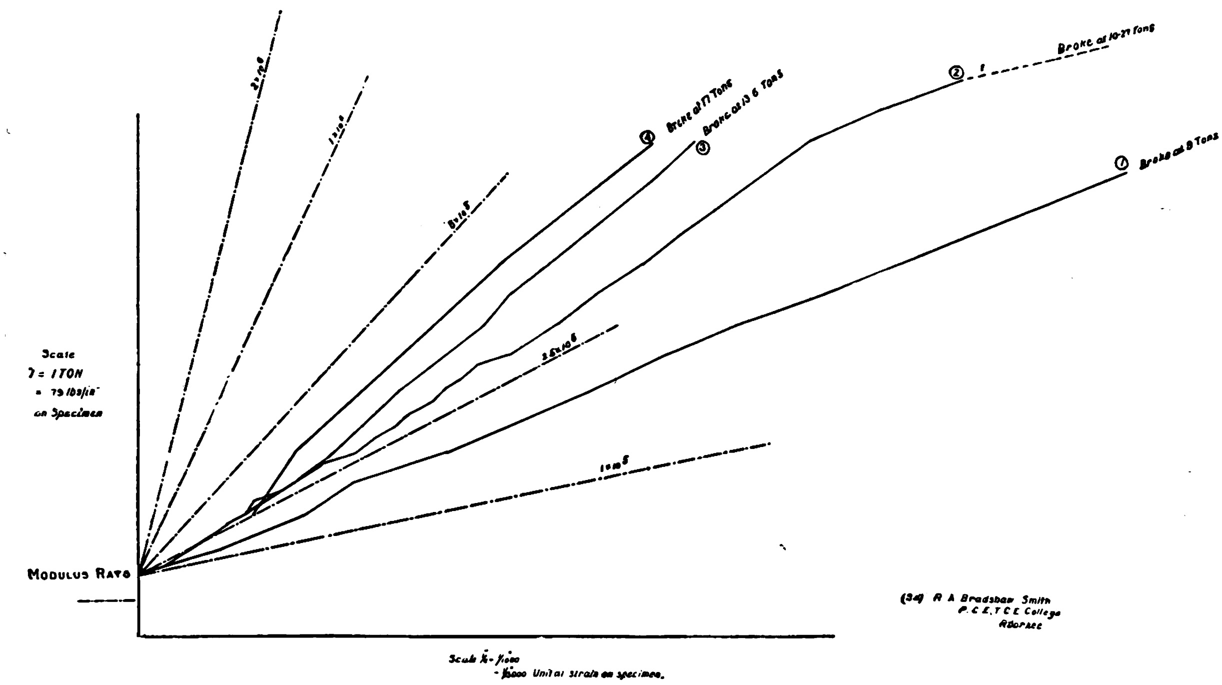
Comparison with actual design.—It is interesting to compare a design in B. B. concrete based on these constants with one in ordinary stone concrete.

DIAGRAM No 1

COMPRESSION TESTS.
BRICK BALLAST & DISTRIBUTARY SILT CONCRETE.

N.B. All specimens cylinders 6" dia 15" high

Specimen	Proportions	Manufacture	Tested	Remarks
No I	4 2.1	16/1/27	15/3/27	Ballast graded 3/4 to 1/2 A.P.C Coy Cement
No II	4.2.1	16/1/27	28/3/27	do do
No III	4.2.1	16/1/27	6/5/27	do do
No IV	4.2.1	16/1/27	23/6/27	do do



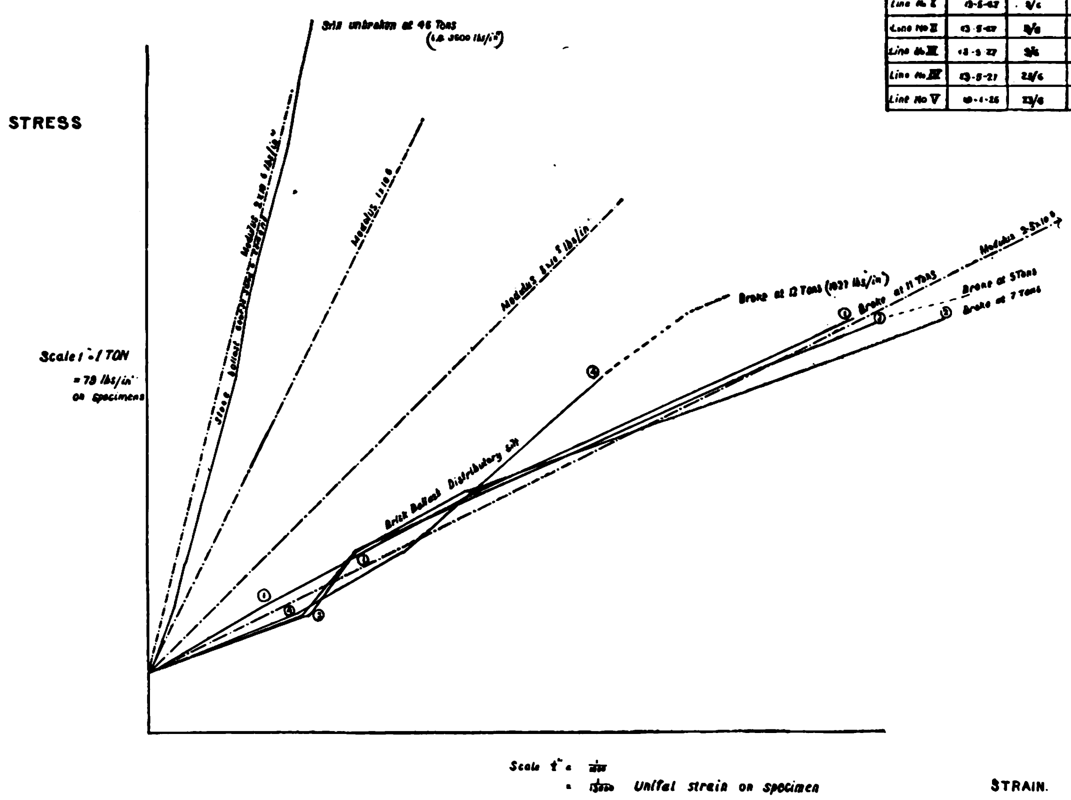
(Sd) R A Bradshaw Smith
P.C.E., T.C.E. College
Roorkee

DIAGRAM No 2

COMPRESSION TESTS
BRICK BALLAST & DISTRIBUTARY SILT. CONCRETE.

N.B. All Specimens are cylinders 6" dia. and 15" high

Specimens.	Manufacture	Tested	Composition	Remarks
Line No I	13-5-27	3/6	5 · 1½ - 1	Brick Ballast Graded ¾" to ½" A.P.C. Coy Cement
Line No II	13-5-27	3/6	6 1½ - 1	(Clinker Ballast) do do
Line No III	13-5-27	3/6	6 1½ - 1	Brick Ballast Graded ¾" to ½" do
Line No IV	13-5-27	23/6	6 1½ - 1	do do
Line No V	10-1-26	23/6	4 2 - 1	Stone Ballast Graded ¾" to ½" Course Sand etc.



(Sd) R A Bradshaw-Smith,
P.C.E., T.C.E. College, Roorkee.

COMPRESSION AND BEAM TESTS ON CONCRETE MADE OF BROKEN BRICK, DISTRIBUTARY SILT, AND CEMENT, AND ITS COMPARISON WITH STONE CEMENT CONCRETE.

Taking a Retaining wall 10′ high

In Stone Concrete and Sand.

$$\text{Base of wall} = d = c\sqrt{\frac{M}{b}}$$
$$= \cdot 096\sqrt{4170 \times 12}$$
$$= 6\cdot 2 \text{ inches}$$

or say with cover $7\frac{1}{2}$ inches.

$$\text{Steel required} = A_s = pbd$$
$$A_s = \cdot 0077 \times 12 \times 6\cdot 2$$
$$= \cdot 057 \text{ square inches.}$$

With B. B. Concrete and Silt.

$$\text{Base of wall} = d = c\sqrt{\frac{M}{b}}$$
$$= \cdot 118\sqrt{4170 \times 12} \text{ inches}$$
$$= 8 \text{ inches}$$

or with cover say 9 inches.

$$\text{Steel required} = pbd$$
$$= \cdot 0051 \times 12 \times 8$$
$$= \cdot 049 \text{ square inches.}$$

We see, therefore, in balanced design the wall would only require 25 per cent. more material and would actually need less steel reinforcement.

As a rough rule if a Brick Ballast Beam is designed with 30 per cent. additional depth keeping the same quantity of steel it will be equivalent in strength to an ordinary R. C. Beam.

To check this rule three beams were made $10\frac{1}{2}'' \times 4''$ and reinforced with 3 No. $\frac{3}{8}''$ rods in exactly the same way as the $8\frac{1}{2}'' \times 4''$ stone concrete beams, with which they were to be compared.

The mean load carried before failure was 2·23 tons as compared with 2·3 tons carried by the latter giving confirmation to the above rule.

It would in most cases be better, however, not to design as a balanced beam but to introduce steel reinforcement to take up the difference of the allowable compression stresses in the stone and brick ballast concrete.

WATER SHORTAGE IN EGYPT.

REUTER informs us in a message from Cairo dated the 12th January, that the water shortage in the Nile is the subject of gloomy comments by "El Mokkattam," which draws attention to the serious outlook for agriculture in Upper Egypt, where the water shortage has frustrated the intention of the fellaheen to grow rice instead of cotton, following a Governmental ordinance restricting the cotton-growing acreage.

It is difficult to understand how the Sudan can justify the abstraction of any Blue Nile water for cotton growing in the Gezira when it is well known that with frequent low Nile, such as the present year, there is need of cutting down of cotton growing in Egypt proper. This year with loss of cotton, followed by inability to get in a rice crop, the unfortunate Egyptians are experiencing a plague of locusts, huge clouds of the insects are moving northward. The Ministry of Agriculture are planning the use of poison gas with the help of the Royal Air Force who have offered their services.

Increase of Blue Nile water and silt being of paramount importance to Egypt the provision of greater storage works than already exist appears to be the solution. The question of providing these at the very head of the river at Lake Tsana is under discussion, but considering the limited collecting area of this lake, the increase is hardly worth expending any large sum of money on. Instead of disputing about the matter with Abyssinia it would probably be wisest to let the American Syndicate do the work of building the proposed dam at the lake outfall and controlling the supplies thereafter. It is pretty certain that the construction of a reservoir and regulator at the lake would not make much difference on the whole to the average periodic supplies that will in any case find their way down the river to the countries where they are used.

There may, however, be other reasons which have not been revealed that are producing the high temperatures of the discussion. For example it has been suggested that somewhere in the vicinity of the lake a nice little hill station would be acceptable for Sudan cotton growers and others and that it would not be wise to mention this to the Abyssinians, who are particularly anxious to keep Europeans out, lest they should begin to appreciate the attractions of part of their country to the extent of settling down in comfortable bungalows on the hill tops round the lake and acquiring the right to construct and control a motor road up the Blue Nile valley from the Sudan. It may be an absurd idea, but there it is and the only way to carry on negotiations regarding the water could seem to be to frankly and openly discuss all points with the Regent, without any reservations. If the water question is really of any importance or is of secondary consequence, it would be far better to say what we are after and have done with it, instead of coming to secret understandings with third parties about spheres of interest and the rest of it in the territory of another. Perhaps expeditions, shooting, scientific *et hoc*, ought to be discouraged and Abyssinia should be assured that, whatever betide, that country will remain as inviolable as Kashmir, as far as the British are concerned, once she has given her word.

RECTITUDO.

THE BRITISH MOTOR INDUSTRY, 1927-28.

PROSPECT AND RETROSPECT.

THE purpose of this short article is to deal rather with symptoms indicative of general tendencies and progress than with the advancement of design in matters of detail. The year 1927 will probably be best remembered, from the point of view of motor history, as one in which the British Industry definitely put forth fully organised exertions to capture or recapture the world's markets, as well as to consolidate its already strong position among users of the road in its own home country.

No good purpose would now be served by recapitulating in detail the circumstances which led up to the position as it was at the beginning of 1927. The main influences which had moulded that position were, to state them as briefly as possible, as follows :—

First, the War, with its accompanying restrictions, had caused a total cessation of the export of British motor vehicles for civilian use of any kind, and consequently opened doors everywhere to the British Industry's competitors and enabled them to establish themselves firmly before any sort of competition could again be organised from Great Britain.

Later came the aftermath of the War, during which factories, the energies of which had been diverted into other channels, had to be re-equipped, with the result that output was trifling and overhead charges very high. During this period, the commercial vehicle section of the Industry suffered from an additional and very serious handicap, inasmuch as its new vehicles were in competition in the markets with its war-time products, new or second-hand, which had become surplus Government stock and had been sold in large numbers and often at ridiculously low figures.

During the past few years, the interest of the British manufacturer in the Overseas markets has steadily increased. Representatives of many of the leading firms have conducted extensive tours, not merely for the purpose of selling vehicles or appointing agents, but also with the object of studying the exact requirements of the countries visited. It was, however, left for 1927 to be the year in which the Industry despatched an official delegation to visit many of the Overseas Dominions in the interests of all its constituents and not merely of individual firms. Much of the good work done by this delegation was of a type the value of which would be almost entirely dissipated if it were

made public. It must therefore suffice to say that very much was learned and that, from a political as well as from a technical point of view, it seems certain that results will ultimately be found to have more than justified the expenditure incurred.

Somewhat closely allied with the tour of this delegation was the opening of a system of propaganda for British motor goods in Empire markets; a costly undertaking but one that was overdue, and that can hardly fail to justify itself, assuming only that the claims made can be substantiated.

On this last point there can be little doubt. The outputs of British factories have been increased, designs have been modified to suit Oversea requirements, and the most modern and economical methods of manufacture have been adopted. The result is that while many British Industries are still striving, with only moderate success, to sell their products at far higher prices than were charged for similar articles before the War, it is now possible to buy at something below pre-war prices in sterling, British cars which far surpass the pre-war models in power, performance, durability, economy and perfection of equipment. Considering the depreciated value of currency, this is no small achievement, a statement which refers to both sections of the Industry and reflects at least as much credit on the builder of commercial and public service vehicles as on the maker of private cars. The former, faced with a long period of trade depression, has had even more difficulties in organising increased output and so reducing standing charges. Nevertheless, many of those who visited the Olympia Shows this autumn expressed astonishment at the value for money represented by many of the heavy chassis there exhibited as compared with anything that could be seen in the lighter classes, irrespective of country of origin.

Great good may therefore be expected to result from the holding of the Motor Transport Exhibition of 1927, which made clear to the world the great progress effected by British manufacturers, not only in the design of vehicles for more or less normal use on satisfactory roads, but equally, or perhaps even more, in respect of the production of vehicles eminently capable of operating under the worst possible travelling conditions.

Yet another event of great significance was the World Motor Transport Congress, held in London last November. This was in no sense designed to serve as propaganda for the products of any one country. Delegates were invited, and in fact attended, from all parts of the world, the unanimity with which the event was supported being in itself the finest evidence imaginable of the fact that the importance of the British Industry is now recognised everywhere. It will be readily appreciated that the possibility of securing representative attendance at any such event is more or less proportionate to the importance of the national industry of the country in which that event is to be held, since those who are brought together seek not only to exchange opinions with one another, but also to learn from examination of the traffic that they see about them, and from the latest products of the home factories. It is, therefore, matter for no little satisfaction that the Congress in London was attended by representatives of far more countries than had ever come together on the occasion of any one of the three Congresses previously held in the United States. The delegates were, moreover, directly representative of something over fifty Governments, as a consequence of which it may be confidently anticipated that the deliberations of the Congress will be reflected within the next few years in national legislation framed in many quarters.

Finally, there are no signs of any slackening of the British Industry's efforts to extend its grip on the world's markets; on the contrary, the degree of success already achieved has been sufficient to encourage many who, a year ago, were doubtful of the wisdom of attempting to develop anything more than a casual trade beyond the boundaries of their own country.

RURAL WATER-SUPPLY AND THE LOAN POLICY.

By L. C. SEN GUPTA, B. E., DISTRICT ENGINEER, RANGPUR.

THE District Boards of Bengal in a Conference held recently at Government House decided to take a loan for the improvement of rural water-supply. It is therefore an opportune moment to discuss the *pros* and *cons* of the question. The main argument in favour of a loan policy seems to be based on the assumption that it is wrong in principle to meet, out of current revenues, the cost of water-supply which will be enjoyed by the succeeding generations. If this is correct of water-supply, it must equally be correct of new roads, bridges and other permanent works of improvement under the District Board. If a loan is to be taken for the water-supply of a district where water scarcity is very great, it may equally be said that a loan should be taken for new roads for a district where good roads are in great demand. A private individual takes a loan for the most urgent item of his household expenditure which he is unable to meet out of his current income. Similarly, a public body, in taking a loan, should take it for a work which is the greatest crying need of the public. Granting that a loan is to be taken by every District Board, should this be for water-supply, roads, bridges or what other purpose? The writer, in his book on "Water-Supply" published in 1917, pages 69-73, discussed this important question of rural water-supply. After discussing various other aspects in this connection the writer goes on:—"The question of rural water-supply and village sanitation is a great problem. It requires the attention not only of the Government but also of every good citizen of the province. We are every year dying by thousands of malaria alone; has any preventive remedy been found out yet? What are the reasons for the unhealthiness of a village? Some say, it is due to the presence of jungle or to the construction of high railway embankments; others,—to the deterioration of rivers and the consequent bad flushing of villages; whatever the reason, the fact remains the same. A village which was fifty years ago in a flourishing condition and a sanatorium for unhealthy people, is now the most malarious place. There are the same tanks, the same pits, the same trees, and possibly the same air; what is then the mysterious influence which has brought about this unhappy change from a village full of life and vigour to a village full of sickness and malaria? Before any scheme is launched out, before lakhs and lakhs of rupees be spent in carrying out big projects, it is worth while to find out the root cause. No doubt the supply of good drinking water to needy villages is a very laudable project. But is it really the bad water-supply which causes all this unhealthiness of a village? The cry of the day is water-supply in rural areas, and Government is constantly asking the District Boards to spend more money on this head specially after the transfer of the Public Works Cess. But, have any statistics been yet collected as to the death-rate in a village, in other words, as to the sanitary improvements effected in a village by excavation of a few tanks or wells? So far as is yet known, no such statistics have been collected. The position therefore is that large sums of money are annually being spent on water-supply without first determining as to whether the evil will be remedied. Attacks of cholera may be less, but it is doubtful whether a good water-supply will drive away malaria, which is the most dire disease in Bengal. Experience shows that, after the provision of a filtered water-supply, many towns show a marked decrease in death-rates from epidemics of cholera, etc., but not from malaria. To drive away malaria, it is necessary to improve the sanitary condition of the village; and this is not done alone by a good supply of water. In most villages, the same system of water-supply as is at present in vogue prevailed fifty years ago, and was considered a model as regards

healthiness. What object, then, are we serving by excavating these wells and tanks? We are giving the villagers a water-supply close at hand, so that where a woman had to walk half a mile to get her *ghara* of water, she has now to go to a District Board well only a few yards away. And yet her children and people may be sick and unhealthy. Sanitary wells or tanks in exceptionally needy villages are no doubt necessary as has been recognised all along by the District Boards; but before starting a systematic campaign throughout the district and spending money on the improvement of water-supply in every village of the district, it is worth while enquiring whether the money to be thus spent might not be more profitably utilized in adopting sanitary measures which would bring back these unhealthy villages into a state of healthiness again. A District Board may spend Rs. 60,000 a year on water-supply, and is probably proud that it is doing so much for the sanitation of the district. Now this Rs. 60,000 every year might perhaps profitably be applied for undertaking a really preventive measure against the insanitary condition of a vast area of the district. The question is—which of these schemes will yield the better results? One should pause before deciding this question." (Pages 67-73.)

It is contended that a systematic campaign of water-supply in the Presidency will drive away cholera from the villages as has been found by experience in the municipal towns where a filtered water-supply was followed by an immediate improvement. Unfortunately, however, rural conditions differ greatly from town conditions in this Presidency; mere supplying a good well in a village or reserving a tank for drinking purposes will not drive away cholera; the villagers must at the same time be taught to drink no other water than the water of the reserved tank or well. From this point of view it may be said that most of the money spent on wells by District Boards is wasted, for people do not always (even during epidemics of cholera) use the water from District Board tanks or wells for drinking purposes. They drink whatever water they can get close at hand such as *dobas*, pools, tanks or their own wells from which water can be had during the year except the months of March and April. Thus public wells, except in special cases, are used only for two or three months in the year when water is not available from any other sources of supply. When several villages or towns are situated by the side of a river or *khal*, an outbreak of cholera in one of the villages is generally followed by outbreaks in other villages down the river. This clearly proves that the outbreak could have been avoided, if the villagers immediately stopped use of the water of the same *khal* or river. It is not a fact that the villages have no other sources of water; it is simply want of knowledge of sanitation and general apathy of the people that are responsible for the mischief. To quote instances—towns like Azimganj, Jiaganj, Murshidabad and Berhampore, situated on the Bhagirathi, suffer from periodic outbreaks of cholera by use of the river water, in spite of the fact that Berhampore has a filtered water-supply and wells are in abundance in the other towns. In the Rangpur district it is said that there is a class of *fakirs* who *chalan* (*i. e.*, transfer) cholera from one village to another. After an outbreak, the villagers pay a decent sum of money to these men to transfer cholera from their village to some other village, a task which the *fakirs* do by polluting the main sources of water-supply of the new village with cholera germs. Naturally, in case of an outbreak of cholera, people dread using the water of any public well or tank open to infection in this fashion and stick to the use of water of their own private wells. What purpose, then, it may be asked, is going to be served by sinking public wells indiscriminately in such villages?

In the Presidency of Bengal the needs of the different District Boards vary so much that it would be a fallacy to assume that a loan for water-supply should be taken indiscriminately for every district. Rangpur is a district where the crying need is communication, *i. e.*, roads and bridges, but not water-supply. The majority of the people of this district are agriculturists: the soil is so fertile that three crops are raised in the course of a year, and the people have means enough to sink wells in their own compounds. Before a person thinks of settling in a village his first thought is of drinking water, and either he builds his house near a flowing river or includes the cost of a well in his budget as a necessary expenditure. People naturally want to be independent in their own supply of water, and no one having means to sink a well will run to a public source of water-supply. Due to the geological formation of this part of the province (North Bengal), specially after the change caused by the great earthquake, the subsoil water is available at a level of 10 to 15 feet of the surface even in the driest part of the year. The construction of an ordinary ring well of such a small depth is extremely cheap, and the water yielded is of fairly good quality. Years ago people could construct such a well at about Rs. 5 each; now the cost would be about Rs. 15 to Rs. 20. Why then should the people of this district approach the District Board to sink such wells? They will find money to construct a well just as they would find money to build their houses to live in. As a matter of fact new roads and bridges are the crying needs of the district of Rangpur but not wells or tanks. The petitions that are received from the inhabitants relate mostly to *hâts*, school compounds, bazars, roadsides, etc. The reason is obvious. People want access to the nearest *hâts* and bazars for disposal of their rich harvest, and the profit they would thus make would enable them to sink their own wells.

The condition of a Western Bengal district differs greatly from that of an Eastern or Northern Bengal district. A village in Western Bengal is a cluster of houses situated close together, a mile or so in length. A big masonry well in such a village can serve hundreds of persons. In the Eastern and Northern Bengal districts villagers live in separate *bustees* each in a house separated from a neighbour by intervening fields (sometimes very large), so that a village consists of nothing but scattered houses. One or two public wells in such a village can hardly serve several houses. So every house is independent in its supply. If now District Boards would sink public wells in such villages, such wells would really be private wells, that is, public wells in private compounds. Everybody knows that there is great abuse in this respect. The writer of this article in his book on Water-Supply (Thacker, Spink and Co., 1917), pages 35-37, mentioned how bad selection of sites nullifies in many cases the benefit of public wells constructed at District Board cost. So far as Rangpur is concerned, the present expenditure of about Rs. 40,000 spent by the District Board and the expenditure of about Rs. 6,000 spent by Government are more than enough; and even this expenditure might be curtailed to meet the urgent needs of communication. The same remarks apply equally well to many other districts of Bengal. Backerganj, for instance, suffer very little for dearth of water-supply. The crying need of this district is the improvement of the existing natural navigable *khals* and channels which are getting silted up and are thus causing all sorts of epidemics. So long as these *khals* were navigable each household tank used to get flushed daily by the rise and fall of tide water. The deterioration of the *khals* is responsible for defective drainage and pollution of drinking water, and their improvement would be a great blessing, a far greater blessing than the excavation of a few wells or tanks. If, therefore, a loan is to be taken for the district of Backerganj it should certainly be for the improvement of these *khals*. In the Presidency Division, specially in the districts of Murshidabad, Nadia and Jessore, the crying need is the improvement of the decaying and dying river systems; and if a large sum of money by any windfall were available, it should certainly be

spent for anything which might restore the rivers to their former good condition in preference to any other works. The scarcity of water-supply in the Murshidabad district is much more than in Rangpur, but this scarcity was not complained of in the past. Rivers in full bloom of their lives were in flowing condition, serving thousands of villages on both banks. The rivers are now dead or are dying, and the villages once served by them are now not only feeling the greatest scarcity of drinking water but are also the abodes of all sorts of deadly pestilences. In the "Bengal District Gazetteer" of Murshidabad (Edition 1914, pages 186-187) it is thus said of Kasimbazar:—"The country about Kasimbazar is very healthful and fruitful, and produce industrious people who cultivate many valuable manufactures. The length of the town was three miles and its breadth was two miles. The population, which consisted chiefly of Hindus, could be estimated at one hundred thousand souls. All these places were originally situated on the curve of the river Bhagirathi; about seventy years ago a straight cut was made forming a chord of the curve, thus changing the course of the river and throwing the towns inland. This engineering operation was followed by the breaking out of an epidemic fever which, in virulence and mortality, is unparalleled by any pestilence save that which destroyed Gaur. In the course of a few years, three-fourths of the population died out; and Kasimbazar from being at one time a most populous place, is now overgrown with jungles and is the abode of wild beasts." Kasimbazar is even now a notoriously unhealthy place, and it is doubtful whether a plentiful supply of drinking water by the excavation of a few wells and tanks will remove this unhealthiness. If the old bed of the Bhagirathi, locally known as the *Katiganga Beel*, could be reclaimed into a flowing river, then only the health of the town would be improved. The question is, if funds are forthcoming, which work should be taken up—the reclamation of the river or the excavation of wells?

It may be argued that the improvement of a single dying river will be too costly an affair to be taken up by an individual District Board. The advantage of taking a loan would be evident here. If all the money taken as loan for the districts of Murshidabad, Nadia and Jessore be combined to improve the river passing through the heart of these districts, there is not the least doubt that the sanitary condition of a large number of villages will show marked improvement, and the scarcity of drinking water in those villages will automatically disappear. A well or a tank in a village can always be constructed by an individual or joint effort of several individuals, whereas the improvement of a river, the re-excavation of a *khal*, or the construction of a trunk road can never be accomplished by joint or individual labour.

An argument in favour of the loan is the fact that the District Boards are not asked to increase in any way their current grant for water-supply. All that they are asked to do is to keep the same allotment, which, instead of being actually spent for water-supply, will go to meet the interest and sinking fund for works already executed under a loan policy, so that, what the District Boards would do for the next 15 or 20 years out of their current revenue, they are asked to finish in the course of two or three years, thus carrying out their programmes as quickly as possible, and there is no additional burden on their shoulders.

The inauguration of a systematic water-supply policy was taken up in 1913 by Lord Carmichael's Government, and in the course of the 14 or 15 years that have since elapsed most of the District Boards have done a great deal to remove water scarcity from rural areas. The question, therefore, can never be as acute as in 1912. A look at the water-supply map of any district in which public wells and tanks already excavated are marked, will indicate that the annual expenditure on water-supply for new wells and tanks which was necessary in 1912 cannot be necessary now. In spite of what might be said on the other side, many District Boards are reluctant to spend one-third of the Public Works Cess for water-supply alone. Sinking of wells or tanks is not an item of work which earns revenue as irrigation does. It should therefore be carefully considered whether the future generations of District Boards should be bound down for years to come to the payment of a fixed sum as interest and sinking fund for a loan taken for an unproductive work, the necessity for which not only varies from district to district in a big province like Bengal, but also varies from subdivision to subdivision, or even from village to village in a big district like Mymensingh. Once the loan is taken and spent, the District Boards will have no option in altering or adjusting their water-supply allotment from year to year.

The Gazettes.

Burma, January 10, 1927.

Buildings and Roads Branch.

Leave on average pay for six months and, in continuation thereof, leave on half average pay for ten months, for a total period of sixteen months, is granted to Mr. F. G. Burns, I. S. E., Assistant Executive Engineer and officiating Executive Engineer, Brickfields Division, with effect from 17th February 1928, or such subsequent date as he may avail himself of it.

On return from leave, Mr. H. Hughes, I. S. E., Executive Engineer, is appointed to officiate as a Superintending Engineer, and is posted to the charge of the Irrawaddy Circle, *vice* Mr. A. F. Chapman, I. S. E., Executive Engineer, placed on special duty.

On relief of the charge of the Irrawaddy Circle, Mr. A. F. Chapman, I. S. E., Executive Engineer, is placed on special duty in the office of the Chief Engineer, Public Works Department, Buildings and Roads Branch. The special duty is equivalent to the charge of a Public Works Department Division.

Leave on average pay for eight months and, in continuation thereof, leave on half average pay for two months, for a total period of ten months, is granted to Mr. N. D. Howe, Temporary Engineer, with effect from 12th January 1928, or such date as he may avail himself of it.

Leave on average pay for eight months and, in continuation thereof, leave on half average pay for four months, for a total period of twelve months, is granted to Mr. A. F. Chapman, I. S. E., Executive Engineer, with effect from 12th January 1928, or such subsequent date as he may avail himself of it.

Irrigation Branch.

Leave on average pay for six months is granted to Mr. G. C. Cheyne, Deputy Conservator of Forests, on special duty in the Public Works Department, Irrigation Branch, with effect from 17th January 1928, or such subsequent date as he may avail himself of it.

Bihar and Orissa, January 25, 1928.

Irrigation Department.

Mr. L. M. Priday, officiating Chief Engineer and Secretary to Government, Irrigation Department, is reverted to the rank of Superintending Engineer, with effect from 18th January 1928, and is posted to the charge of the Son Circle.

On being relieved by Mr. L. M. Priday of the charge of the Son Circle, Mr. C. S. Saunders, Executive Engineer, is posted to the charge of the Dehri Division.

On being relieved by Mr. C. S. Saunders of the charge of the Dehri Division, Babu V. Kanakratnam, officiating Executive Engineer, Dehri Division, is reverted to the rank of Assistant Engineer.

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INDIAN ENGINEERING.

SATURDAY, FEBRUARY 11, 1928.

SIR WILLIAM WILLCOCKS, K. C. M. G.

II.

IN the first chapter of this article Sir William Willcocks' views on the possibilities of additional storage at the Aswan dam were mentioned, but he was fully aware of the dangers of large supplies of perennial water to a country where the sub-soil water level is high. It was a point he dealt with in the first two editions of his valuable work on "Egyptian Irrigation," in the third edition of the same work he referred to it with more insistence, three times before the Royal Geographical Society he lectured on the necessity of lowering the level of the subterranean water table, and again he devoted a whole paper to the subject in a communication presented to the Institute of Egypt. The first serious work entrusted to him as a young engineer in India was that of drainage in the tract irrigated by the Ganges Canal to remedy the conditions induced after the monsoon season of 1878, and it was a lesson he never forgot. Egypt had once been irrigated by the basin method, and the method is described in "Egyptian Irrigation." It is distinct from perennial irrigation in that it is carried out by canals running only flood water, and Sir William said of it in his book that considering the times of flood and low supply, the climate of Egypt, the turbidity of the Nile floods, and the deltaic formation of the Nile valley, no better system than the basin irrigation as practised in Egypt could possibly be devised. It is the most efficacious method of utilising existing means of irrigation which the world has witnessed, and it has stood without a rival for some 6,000 years.

In his pamphlet on "Egyptian Irrigation and the Public Health" of 1927, Sir William pursued the subject further. He said: "Perennial irrigation is no hardy plant like basin irrigation. It is not like the indestructible Pyramids, but is typical of the structures of our days, the dams and weirs on the Nile, which need unremitting toil and observation to preserve them from destruction. Perennial irrigation, as Dr. Schweinfurth has well said, is one unending struggle against salt. It is also an unending struggle against water-logging." In his report on the Aswan Reservoir, there is a passage which is reproduced in the pamphlet above referred to: "We know now that in future *drainage works must precede irrigation works in Egypt*" (italics his). In his report on the Irrigation of Mesopotamia, he said: "No sooner had Alexander the Great fixed the site of the head of the Pallacopus than he turned to the drainage of the country. Here was the true irrigation engineer * * * One has only to see the irrigated tracts of the lower reaches of the Khalis Canal to see the damage which can be done by irrigation without drainage." There is an old prophecy that Babylon, the glory of kingdoms, would be overthrown as God overthrew Sodom and Gomorrah, and turned into a desolate desert. The prophecy, as we

all know, was fulfilled, and Sir William Willcocks ascribes the fall to perennial irrigation. In what was once the richest province in Egypt, there has been such a rise of sub-soil water that it scarcely pays to grow cotton over very large areas. In another rich belt salt has accumulated. Everywhere the same tale is told, and the yield of cotton has been brought to a kind of minimum over extensive areas. In addition, too, to the loss of fertility of the soil, there is the menace to the health of the people, which is an even more important matter, and ill-health in Egypt is on the increase. In the vital question of public health and public wealth, Sir William says that sound engineering, sound agriculture and sound sanitation have one common goal, and he advocates the spending of many millions of pounds on drainage and many millions again on the filling up of disease-spreading depressions. These remarks come from a thoughtful irrigation and agricultural engineer of great experience, and if some stress is laid on them it is because the warnings are not unneeded in India. The old irrigation methods of Sind are similar in many respects to the old basin methods of Egypt, but it is now sought to replace them by perennial irrigation without any precautions, and a high intensity of perennial irrigation in the Indus delta will bring the usual troubles in its train. To the Panjab warnings ought not to be needed, the province has had warnings before, and has yet allowed large areas on the last completed project to become water-logged, and is at work on another great project where the same evils are likely to ensue.

In 1895, Lord Cromer appointed Sir William Willcocks Director-General of Land Tax Adjustment; but lest it should be thought that it was a strange appointment for an engineer, the work was in no way strange to Sir William. The land taxes in Egypt are practically water taxes, the new Director-General was not without knowledge of land values, and he brought to bear upon his future duties his customary energy and incisive insight. An adjustment of the taxes was very much needed, it led in some cases to influential men's taxes being multiplied many times and to poor men's taxes being halved. It was decided that the maximum taxes of the future were not to be higher than the maximum existing taxes, and this took away all fear from the fellaheen and encouraged them to give accurate information. The fellaheen, indeed, took an extraordinary interest in the adjustments, and showed much appreciation of their fairness. Large and influential land-owners whose taxes were raised were not equally pleased, though there were some very gratifying exceptions, notably Nubar Pasha the Prime Minister, one of whose villages was raised from 18 to 100 piastres. The work was brought to a very successful conclusion, and as the new taxes were to remain in force for thirty years, the moment the new tax was fixed everyone was encouraged to improve his property to the utmost. Sir William occupied this appointment for two years, and in 1897 retired from Government service, but by no means from active work.

(To be continued.)

THE FUTURE OF COAL.

THE home coal industry has had about as disastrous a time as any industry could have. It was the great industry of England, the national prosperity depended on it, and as it received blow after blow the cloud overhanging it cast a gloom over the industrial position of the country. The calamitous strikes, strikes even during the anxious period of the war, were one of the causes, and so it happened that the trouble given by the coal miners in the United Kingdom gave an extraordinary fillip to the use of oil instead of coal. Oil had the drawback that it was not a home product and it had to be imported from foreign countries at the cost of millions of pounds; but then it had certain advantages. When strikes made coal unobtainable, oil could be purchased and the supply was reliable, oil was moreover more cleanly to use, and the fuel space in ships could be reduced to about a half. The war had ended only about two years, and over 90 per cent. of the British Navy was using oil. The report for 1920-21 of Lloyd's Register of Shipping showed that the tonnage of ships burning oil increased from 1,310,209 in 1913 to 12,796,635 in 1920. The oil consumed was equivalent to about 20 millions of tons of coal per annum, and this was the figure for shipping alone, it did not include the numerous industrial undertakings which changed their installations from coal to oil in consequence of the frequent strikes. The subsequent prolonged strike did not obviously improve the situation of the coal industry, the greater the trouble caused by the miners the more were industries of all kinds driven to the use of oil.

In a different way, the discoveries of recent years as regarding pulverised coal affect the question in some degree. The use of pulverised fuel means that coal is still required, but when a very high efficiency can be obtained by means of pulverised-fuel firing less coal is wanted, and the question is affected also by the fact that low-grade coal in a pulverised form can be used with high efficiency. An inferior grade of coal may possibly be mined more easily, be nearer to the locality where fuel is wanted, and be obtained with less difficulty than coal of superior quality. America has not by any means been free from coal troubles, and the "Manchester Guardian" has lately described a lamentable state of affairs as existing between capital and labour in the coal-mining areas. But there is great inventiveness in America, and it is in America that the developments in the use of pulverised coal have been particularly active. It is said that with the new systems invented there can be a saving in fuel of as much as 20 per cent., with a reduction of labour of also about 20 per cent., with a plant of less cost, less wear and tear, and that even low-grade slack can be used. It seems quite certain that the more acute the coal difficulties owing to trade union action, the greater the incentive to overcome them by all the ingenuity that human wisdom can devise.

But that will not dispel the depression that has fallen on the normal state of the industry in England, and it is refreshing to read of the optimism displayed by Mr. Frank Hodges in his address to the Tyneside

Lecture Society a short time ago. Mr. Hodges says that a time is coming when oil and gases will be extracted from coal and prove of immense value for the production of power and energy, while the residual coal in a pulverised state, after the more precious oil and gas have been extracted, will be used instead of bunker coal and will be more economical than its oil rival. Mr. Hodges claims that this will make Britain independent of the world's oil supply, that it will lead to abundant and cheap power in the country, and that the bunker trade will be recaptured. There are people who think that Mr. Hodges is far too sanguine, but one never knows. The Rev. W. H. Draper in a recent book tells a story of an effort to raise subscriptions for a fund to increase the stipend of a starvation living. In the parish, there happened to be kennels belonging to a hunt, and one of the workers in the charitable cause called on the kennelman for a contribution, however small, to add to the income of the vicar. The kennelman scratched his head and said: "Well, sir, I'm sorry for him and sorry to say nay to you and the bishop, but in spite of that I ain't going to give nowt, an' I'll tell you for why. The head huntsman and me have been talkin' it over, an' we both of us think that Parsons are like 'ounds, an' that they do their work best on an empty stomach." There are a good many of us who do their best work on an empty stomach, and the impoverished state of the coal industry in England may lead those concerned in the direction of productive inventiveness to meet the "narrowing horizons," as Mr. Hodges puts it, of the present situation. If the efforts are successful, there may be something in the results for India to learn, for in India also there are coal problems.

RAILWAYS IN THE RECHNA DOAB.

THE opening of the Lyallpur-Jaranwala Railway by His Excellency the Governor of the Panjab a few weeks ago and the fact that it was said that this was the first of four, or possibly five, new lines to converge on Lyallpur show how remarkable has been the development of the tract of country between the Chenab and Ravi rivers in a short span of years. In the nineties of the past century, and indeed in parts of the doab for some time after that, the landscape of the tract was characterised by features of almost unparalleled monotony. It was a country of which it could be said:

> "No sound of cheerful toil is swelling,
> There is no quickening spirit here,
> Earth has no home and man no dwelling."

It was just a stretch of nearly rainless, and altogether barren wastes, dotted at the best with sad-coloured *jal* jungle. The *jal* trees afforded their little scraps of shade, and there the indigenous tribes, the *Junglis*, with their goats and camels, occasionally foregathered to seek shelter from the scorching rays of the sun or to partake of the slimy *pilu* berries. The *Junglis* said that there was no shade so cool as that of the *jal*, and that was perhaps because they knew no other. The cobras seemed to think so too, the tract was full of these deadly snakes, and they loved to lurk among the gnarled roots of the *jal*. Here and there were the remains of extinct villages, marked by the strewn scraps of shattered earthenware, and how these villages were ever able to exist can only be conjectured. They could only have thrived under very different conditions, and possibly the lands were then subject to river inundations. The *Junglis* were not agriculturists, they were cattle-lifters, freebooters, people of that kind, accustomed to prey on their more fortunately circumstanced brethren of the river banks, and with impunity, for all the central part of the doab was as inaccessible to ordinary mortals as a fortified citadel. The tract was in the main destitute of life, even the ubiquitous grey partridge would have nothing to say to it, the roving sandgrouse and chinkara found the distances to water too great for their restless activity, for miles and miles in any direction there was the same dearth of landmarks, the same death-like silence and desolation.

The first scheme to reclaim the desert by means of irrigation, submitted for sanction in 1875, was thrown out by the Government as too uncertain of success, and the abortive project, sanctioned in 1884, was a lamentable failure. It was not till 1892 that an estimate for the Chenab Canal was sanctioned in a form that made it destined to be the most profitable irrigation scheme of all India; and the work was carried out so rapidly that the project estimate was closed on the 31st March 1900. There were certain extensions in progress at that date, but also extensions not contemplated in the project were completed before the close of the year 1899-1900. And while the work was in progress irrigation was under development, so that the whole interest charges were wiped out in 1898-99, and by the end of 1900-01 the accumulated profits amounted to Rs. 43,05,843. The success of the scheme, in all its aspects of engineering, colonisation and financial returns, was so immediate and so greatly in excess of the most sanguine anticipations that any adverse comments can only be made with reluctance. Yet it has to be said that a point of vital importance to the project was neglected, and the point was that of communications. It might conceivably be held that the canal authorities were in some measure to be blamed for not having taken stronger action earlier in the day to press upon the Government the urgent need for transport facilities; but it has to be remembered that the irrigation engineers of the Panjab had taken prompt and effective action to retrieve the disaster of the first Chenab Canal and the haste in which they had to work prevented them from giving the necessary time to the transport question. As soon, however, as they realised the rapidity with which irrigation was going to develop, they never ceased to plead for railways for the carriage of the produce to a market, and for the delay which subsequently occurred they were in no way responsible.

The irrigation was not only extraordinarily rapid in its development, but the fertile soil was yielding magnificent crops, and the only blot on a scheme of

very unusual success was the want of transport. The sub-grade work of the Wazirabad-Lyallpur Railway, the first railway of the doab, was carried out by the canal engineers in spite of the discouragement of the Railway Department which seemed to have doubted that it was wanted, and it was not till 1895 that the North-Western Railway sent engineers to complete the line with any old permanent way material unfit for other use. This first railway, opened in lamentable circumstances, proved invaluable, but altogether inadequate for the needs. It helped greatly to increase the earnings of the North-Western system, and made it clear that further railways to serve the whole doab would be profitable, directly and indirectly. Still, there was delay and, though crops were rotting on the ground for lack of carriage and the unmetalled roads of the tract were cut to pieces by the traffic, the additional lines came with incomprehensible slowness. In these circumstances, the Lyallpur-Jaranwala branch, late in the day as it is, is a matter for congratulation, as also is the statement that before long there will be other branch lines converging on Lyallpur. In the early nineties there was no Lyallpur, where Lyallpur now is was a desert, but it is now the headquarter town of a great irrigation project, and its claims should not be overlooked.

IRRIGATION IN THE UNITED PROVINCES, 1925-26.

THE irrigated area of productive, protective and minor works (now called productive, unproductive and miscellaneous) in the United Provinces, sometimes fairly steady for a sequence of some years, is nevertheless liable to fluctuations. The table in the administration report opens with 1892-23, in which year a total area of 1,799,846 acres was irrigated. In 1984-95 the area had dropped to 929,461 acres and in 1896-97 had risen to 3,023,884 acres. The 3 million figure was topped in nine of the subsequent years, the record year being 1918-19 with an area of 3,694,863 acres. Since 1921-22, inclusive, the area has been steadily less than 3 millions, and in 1923-24 it was as low as 1,990,104 acres. Owing to these variations, the financial results show variations also. In 1892-93 the percentage on capital for the productive works was 5·54, and then with ups and downs the maximum of 10·24 was reached in 1919-20. In 1924-25 the return was as low as 4·59 per cent. The working expenses are now higher in consequence of the higher rates of labour and materials, in 1895-96 they were Rs. 21,63,100, a significant rise took place in 1920-21 when the figure was nearly Rs. 45¼ lakhs, and since then the expenses have been over or approaching Rs. 50 lakhs. The protective works have never done well financially. The working expenses, which have been as small as Rs. 92,627, have been well over Rs. 8 lakhs in the last four years for which the statistics are given, though of course there have been some new protective works in the interval. Regarding financial results, of the thirty-four years shown in the table, the percentage on capital was a minus figure in twenty-one years, and only in one year was there a plus figure of over 1 per cent. These works were not expected to be remunerative, but neither was it expected that the yield would be so poor as has been the case. The percentage figure of the minor works varies from a maximum of 6·05 to a minimum of 0·90. The above is a general survey of the years for which figures are given, but the administration report for the year ended 31st March 1926 says that, excluding the amount expended on the Sarda scheme which is in course of construction, the net return of the productive canals which are earning revenue was 4·37 per cent., and that the net loss of the unproductive works, taking interest charges into consideration, was Rs. 11,93,792. The Sarda project, a project of great magnitude and cost, is the outstanding feature of the operations of the day, and much will depend on the results that follow its completion. The tracts that the canals of this project will irrigate have a higher rainfall than those where the demand for water is steady, and in all the circumstances of the Provinces as a whole, there is much reason to doubt whether the scheme will fulfil the productive anticipations of the project-estimate.

Meanwhile the progress has been very active, the capital outlay to the end of the year 1925-26 has amounted to Rs. 4,38,76,930, and sums of Rs. 29,78,688 and Rs. 72,09,822 were spent on the Sarda-Kichha feeder and Sarda-Oudh canal respectively during the year. The first four bays of the barrage have been completed and work on the next eight was in progress at the end of the year. The regulator was nearly completed, and good progress has been made with the main canal, branches and distributaries. Much survey work for drainage has been carried out, though the work of drains in most places cannot be undertaken till water is available from the new canal channels to take the place of the irrigation water now drawn from the swamps which will be drained. It is anticipated that a part of the project will be opened for irrigation during the *rabi* season of 1928-29, after which further developments are likely to be fairly rapid. The whole work has in fact been pushed on with much vigour.

The year was, generally speaking, a prosperous one. The monsoon rains were well distributed and plentiful, the winter rains were scanty, but the rivers behaved well, and the area irrigated was over 500,000 acres in excess of that of the previous year. There were no exceptionally high floods and very little damage was done to any of the canal works. The Governor in Council placed on record his appreciation of the excellent work done during the year by the Chief Engineers, Mr. B. D'O. Darley and Mr. Jwala Prasad, and the officers serving under them. And specially mentioned in the report for good services are Messrs. M. R. Richardson and J. S. S. Lee, Executive Engineers, Mr. A. L. Eastwood, Assistant Engineer, and Mr. G. Lacey, Under-Secretary and Personal Assistant to the Chief Engineer, Sarda Canal, for his valuable original work in connexion with the design of distributary channels. Regret was expressed at the death of Lalla Thakur Dass, an Assistant Engineer of great promise, who was killed by an accident on the works in November 1925.

Notes and Comments.

The Kennedy Medal.—It may interest our readers to learn that the article by Sheikh Minhaj-Ud-Din, Indian Service of Engineers, Punjab Irrigation Department, on the "Bend Outlet" published in INDIAN ENGINEERING, in the issue dated 13th February 1926, has been awarded the Kennedy Medal in the competition ending October 1927.

The Automatic Telephone in India.—In the illustrated article under the above title in our issue of 28th January last, the name of Messrs. F. and C. Osler, Ltd., who are Sole Agents in India for the Automatic Telephone, was by an oversight omitted. We would draw special attention of our readers to the firm's advertisement on the front cover of this issue.

"Concrete Blocks, Slabs and Bricks."—In a note reviewing the above pamphlet, which appeared in our last issue, it was said that the booklet could be obtained gratis on application to the Secretary, The Concrete Association of India, Home Street, Bombay. We now learn that the booklet can also be obtained from The Concrete Association of India, E-2, Clive Buildings, Calcutta.

Opening of New Railway.—On the 15th instant His Excellency the Governor of Bengal will perform the opening ceremony of a section of the new metre-gauge railway—the Dinajpore-Ruhea line—on the Eastern Bengal Railway. The entire length of the new line will be 49¾ miles, and the section to be opened by His Excellency is 24 miles. It will serve the northern part of the Dinajpore district, in North Bengal, an important rice-growing area.

New Tyne Bridge.—This new single span bridge over the Tyne at Newcastle, carrying tramway lines and a roadway for four lines of traffic, and elevated 84 feet above high watermark, is nearing completion. The length of the bridge where it actually crosses the river will be 581 feet but the steel approaches borne high over the sloping banks and quays of the river will bring the overall length to 1,270 feet. There will be over 5,000 tons of steel in the bridge. The masonry approaches add another 581 feet to the length of the work. The total cost will exceed £1,100,000.

Sahara Resurveyed.—Three young Englishmen, Francis and Peter Rodd, sons of Sir Rennell Rodd (late British Ambassador, Rome), and Augustus Courtauld, have returned to England after many months spent in resurveying the Sahara. They travelled by camel and the equipment included a specially-designed portable wireless set. With this they picked up time signals by means of which they fixed the latitude and longitude of mountains and valleys, and found the existing maps in many cases inaccurate. The maps made are being presented to the Royal Geographical Society.

New Hill Station.—A new hill station in Gujerat will soon be an accomplished fact. The beginning of it was inaugurated on the 1st instant at Dharampur, by the Governor of Bombay. His Excellency said he had every reason to hope that a model and flourishing hill station would be a definite reality within a much shorter time than anybody would have thought possible. Its development would be greatly helped by the improvement of communications which the projected railway line from Bulsar to Dharampur would effect. The station, which has been named after His Excellency as Wilson Hills, would serve Bombay, Surat and Ahmedabad.

Local Advisory Committee, B.-N. R.—The 13th meeting of the Bengal-Nagpur Railway Local Advisory Committee was held on 3rd February, Mr. Pallister Young presiding in place of the Agent, Mr. Carroll, who was away on tour. Dealing with a complaint that the overhead tanks of Inter and 3rd Class carriages were sometimes allowed to leave Howrah empty, the Chairman said that this subject had been given considerable attention since it was discussed at a previous meeting. It had now been arranged to make a senior carriage official personally responsible that all tanks are filled before the rake goes into Howrah, and Mr. Young thought that this measure should obviate any future complaint of this nature.

Severe Tests for England's Concrete Roads.—Within the past few weeks of snow and floods several of the concrete roads in England have undergone extremely severe tests which they have withstood without suffering in any way. When the Thames overflowed in London the all-concrete section of road on the Chelsea Embankment was flooded to a depth of four feet but the roadway was found to be unaffected when the water subsided. Several other concrete roads, especially in Surrey, have been submerged under flood water and have not disintegrated in any way. A snowdrift eight feet thick was piled up for practically three weeks on the concrete section of the Warlingham-Botley Hill with no adverse effects whatever on the road surface.

Willcocks and Malaria in Bengal.—The invitation given to Sir William Willcocks to visit Bengal and investigate the subject of malaria and irrigation is quite as it should be. Sir William has a great reputation as an irrigation engineer, in fact there is no irrigation engineer in the world who is so widely known, and though his experience has lain mainly in Egypt his knowledge has so great a range that he is not likely to misunderstand the special conditions of Bengal. To the malaria question also he has given much thought and study as evidenced by the lecture he delivered last December in Cairo. His views regarding irrigation and malaria should therefore be very valuable, and it will be most interesting to learn the conclusions he arrives at.

Mysore Engineers' Conference.—This Conference concluded its sittings at Hebbal on the 3rd instant. The reading of professional papers took up most of the time. The following were some of the more important subjects:—Evolution of architectonics, place of oil engines in hydro-electric schemes, manufacture of cyanamide, and decay of stone, which were discussed by experts. Interesting papers were read on towns and how to improve them, underground water supply and roads in Mysore. Delegates visited electrical and other laboratories of the Indian Institute of Science, where Professor Catherson Smith gave wireless demonstration. Mr. K. S. Seschar, Chief Engineer and Secretary to the Mysore Government, was elected president for the year.

Jamuna Erosion.—The Hon'ble Nawab Saiyid Nawab Ali Chaudhuri, C. I. E., Member of the Executive Council, Government of Bengal, visited Serajganj recently in connection with the erosion of the river Jamuna. The Executive Engineer, Superintending

Engineer, and Rai A. C. Dutta Bahadur, District Magistrate of Pabna, also visited the place in this connection. A deputation waited upon the Nawab Bahadur, praying for the undertaking of protection work in order to save the town from the fury of the river. The Hon'ble Member is reported to have replied to the deputationists that protection work would be undertaken if it was possible. It is understood that the Chief Engineer to the Government of Bengal will be deputed to examine the river this month.

Nizam's Guaranteed State Railway.—Sir Robert Highet, Managing Director of this Railway Company, who is now on a tour of inspection in India, attending the fifth meeting of the Secunderabad Local Advisory Committee, discussed the proposals of the Railway Company to discontinue the additional trains on the suburban service, which were introduced in September 1926, as they had failed, and also to increase the minimum tax from one to one and a half annas. It was agreed that the changes should not be introduced until the plague epidemic had subsided. The chairman reported progress on the several railway lines under construction and intimated that the Nizam's Government had sanctioned the construction of a light broad gauge line from Vikarabad to Bidar.

Survey of India.—Colonel Sir Charles Close, who served in the Survey of India from 1889 to 1893, chiefly employed in triangulation work in Upper Burma, has been appointed president of the Royal Geographical Society to fill the vacancy created by the death of Dr. Hogarth. The High Commissioner for Iraq has brought to the notice of the Government of India the excellent work of Major C. G. Lewis and the Survey of India detachment under his command in connection with the Turco-Iraq Boundary Commission. The Chief Commissioner of the N.-W. Frontier much appreciates the valuable services rendered by the Frontier Circle of the Survey of India in the resettlement operations of the Peshawar District. Special mention is made of the assistance received by the Settlement Officer from Rai Sahib Mayadas Puri, the officer in charge of the detachment deputed for the purpose.

Automatic and Electric Furnaces, Ltd.—This firm who are the manufacturers of the well-known Wild-Barfield furnaces, with their Elecfurn Works, North Road, Holloway, London, N. 7., will be exhibiting at the British Industries Fair, Birmingham, next month. There will be three Wild-Barfield Automatic Hardening Furnaces in actual operation. One vertical type will be worked by Messrs. Charles Taylor (Birmingham), Limited, for hardening the pinions of their well-known chucks, and two of the horizontal type will be operated, one by Messrs. B. S. A. Tools, Limited, for the production hardening of their taps and dies, and the other by Messrs. Moss Gears, Ltd., for gear hardening. This latter size is the largest size that has yet been shown at the Industries Fair, having a maximum output of 170 lb. of gear wheels per hour, with a consumption of only approximately 15·0 kilowatts. All the above furnaces indicate the non-magnetic, *i. e.*, correct quenching point of the various steel parts. In addition to these there will be the standard Wild-Barfield High Speed Steel Hardening Equipment and Annealing Case hardening and Enamelling Furnaces, fitted with automatic control for time and temperature. This exhibit will be the largest practical demonstration of hardening automatically in electric furnaces yet given to the public.

Roads and Aviation in India.—A correspondent of "The Times Trade and Engineering Supplement" comments on the expectations entertained as to what Sir Basil Blackett may be able to provide in the Budget next March for roads and aviation in the country. Roads in all provinces have been backward for want of sufficient funds, and owing to the ever-increasing motor traffic the question has now become a burning one. The Road Development Committee has, it is understood, proceeded far with its investigations, but money has always been the great stumbling-block, and it will be a great feature if Sir Basil Blackett, with his broad-sighted views, can see his way to establishing some system of road finance for the development of road communications. Aviation in India has also lingered, and that too is a matter of finance. It is an Imperial not a Provincial question, and without a Government subsidy it is not easy to see how desirable air services, such as that between Calcutta and Rangoon, can make any progress. The next Budget, which will unfortunately be the last that Sir Basil Blackett has to present, will be awaited with much interest.

Calcutta Advisory Committee, E. I. R.—Mr. G. L. Colvin, Agent of the East Indian Railway, presiding over the 49th meeting of the Calcutta Advisory Committee, held on 3rd February, drew attention to the drop in earnings from merchandise traffic. He said the falling off had commenced at the beginning of January, and for the week ended 28th January there was a drop of nearly Rs. 3 lakhs, as compared with the figures for the corresponding period of last year. Passenger and coal traffic, he said, was good, and he was at present unable to find any reason for the drop in goods traffic, which was chiefly due to decreased receipts of wheat, gram, and pulses from up-country, and to smaller despatches of salt, gunny and sugar from Calcutta stations. He suggested that crops might, perhaps, be late, but the members of the Committee were not able to suggest any reason. Mr. Colvin added that due to the strike in the Docks he was forced to stop coal loading for the Docks, except half train loads for any particular ship. The Port Commissioners were, he said, accepting three train loads a day, but he already had seven trains awaiting despatch.

Electric Traction.—A useful technical paper, issued from the office of the Railway Board of India, is one by Mr. A. R. Gundry, M. I. E. E., M. I. M. E., Electrical Engineer, Eastern Bengal Railway, on the subject of Electric Traction. The paper is intended to serve as a guide to railway engineers interested in that form of traction. The first section of the booklet deals with information required for estimating the cost of a proposed overhead electric train service, with an example of the calculation of energy consumption, and concerns engineering, traffic, locomotive and electrical staff. A second section gives data concerning the maintenance costs of overhead electrical equipment and electrically equipped cars, and concerns electrical engineers and rolling stock engineers. A third section shows the organisation of the electrical engineer's department, and the system adopted for the maintenance and general overhaul of electrically equipped stock. A fourth section is general and concerns electrical engineers, rolling stock engineers and the auditor. Additional information is given in ten appendices, to which reference is made as necessary in the body of the paper; and an eleventh appendix gives the rules and instructions as applied to electrified lines in England. Altogether, the paper contains a great deal of practical value to the student.

Bengal Forests.—A resolution of the Government of Bengal on the Administration of the Forest Department states that including unclassed and other forests the total area under the control of the Forest Department was 10,601 square miles. A heavy cyclone passed over the southern portion of the Cox's Bazâr subdivision in May 1926 and for some time disorganised the work in that area. The river Teesta flooded the Chengmari Forest and killed some sâl trees (*Shorea robusta*) in this area. The rivers Mechi, Teesta and Hasimara caused some damage by erosion. The river Sankos has returned to its old bed, and the Bholka Forest is now safe. Revised working plans for the Jalpaiguri and Buxar divisions were under compilation, and the revision of the Kurseong and Sunderbans working plans were taken up in the latter part of the year. The full programme of regeneration could not be carried out, but 1,994 acres were taken up during the year, against 1,511 acres in the preceding year. The saw mills at Sukna and Toong are working satisfactorily. The largest demand for sawn timber was from the Eastern Bengal Railway and also from the tea gardens.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 26th January :—Messrs. Martin and Co., Calcutta—Spares, for Ruston Dragline Excavator, Rs. 23,825 c. i. f. Karachi; Spares, for Ruston Dragline Excavator No. 135, Rs. 3,312 c. i. f. Karachi; 173 Joists, R. S., of sizes, Rs. 2,487 f. o. r. Howrah; 85 Joists, R. S., of sizes, Rs. 2,472 f. o. r. Howrah; Messrs. Jessop and Co., Ltd., Calcutta—Spares, for star drilling machine, Rs. 4,753 delivered free at Karachi railway station; 1 machine, punching and shearing, Rs. 4,140 f. o. r. Calcutta; Messrs. P. Orr and Sons, Ltd., Madras—12 Levels, reversible, 14 inches, by Messrs. Cooke, Troughton and Simms, triplicate drawn tubing for telephonic body and draw, complete with accessories, Rs. 5,670 delivered free at Rahim-Yarkhan railway station, *ex* stock; 9 Levels, reversible, 14 inches, by "Orr," triplicate drawn tubing for telephonic body and draw, complete with accessories, Rs. 3,204 delivered free at Rahim-Yarkhan railway station, *ex* stock; 35 pairs Levelling staves, 14 feet, closing to 5 feet 3 inches, of solid teakwood, telescope brass bound, heeled and cap, Rs. 1,750 delivered free at Rahim-Yarkhan railway station, *ex* stock; 6 Theodolites, 5 inches, I. S. D., Rs. 5,670 delivered free at Rahim-Yarkhan railway station, *ex* stock.

Indian States and the Butler Committee.—"The Princes have exhibited some anxiety lately as to what the future has in store for them—an anxiety from I notice that some even of the communities of British India are not free. The Princes are in no way out of sympathy with constitutional advance in British India, provided it is presented to them untainted by any suspicion of change in their internal sovereignty or in their position *vis a vis* the British Crown, and in lines calculated to tend to the peaceful development of the Indian Empire. The Indian States are geographically and economically bound up with British India, and we owe it to Your Excellency's friendly attitude and wise statesmanship that this connection with its common rights and interests is to be fully explored by an expert committee with the object of securing a friendly co-ordination of the interests of both sides, and the promotion of an effective partnership between the States and British India, which seems so essential to the future welfare of the country." (Speech of H. H. the Maharaja of Jodhpur at banquet to Their Excellencies the Viceroy and Lady Irwin.) In his reply Lord Irwin said His Highness had referred to the geographical and economic links which bound together British India and the Indian States, and to the reactions which constitutional advance in British India might have on the position of the States. His Highness was aware that a committee under the chairmanship of Sir Harcourt Butler was now enquiring into certain aspects of the relationship between the Paramount Power and the States and he hoped and believed that this enquiry would provide a sound basis on which they would be able, in due time, to build. In the meantime he would only say that he believed that if there was on both sides goodwill and a common desire to find for the various problems a solution which would conduce to mutual prosperity and progress, they could face, without anxiety, whatever the future might have in store.

Back Bay Developments.—It is computed that the total cost of the prosecution of Mr. Nariman will be over Rs. 50,000. As the prosecution which the Government sanctioned has failed, endeavours may have to be made to recover some of the expenditure, if not the whole, from Mr. Harvey, who, it will be remembered, went on leave to England without waiting to hear the judgment pronounced. If Mr. Nariman had been convicted the Government would not have been inclined to share expenses. The enquiry has failed to show the Magistrate that Mr. Harvey was guilty of more than mismanagement, incompetence or carelessness. But the Mears Enquiry had already established "regrettable laxity of administration" of the Development Department as a whole, as well as against particular individuals, high and low. It thus comes about that Government itself should be held to be chiefly responsible for the terrible waste of public funds that has taken place from first to last. The Government depends upon the taxpayer to put his hand deeper into his pocket to drag them out of the muddle the public had no part in bringing about and over the exposing of which the undaunted Mr. Nariman has pertinaciously withstood all attacks on himself. When Mr. Harvey filed his suit against Mr. Nariman, the latter instituted his case against Sir Lawless Hepper, whose solicitors in England accepted the service of summons at the time. Now that his goodwill has been established in regard to the accusations of Mr. Harvey, Mr. Nariman is said to propose ascertaining whether the acceptance still holds good. The more light that is let into the Back Bay business the better. Is there to be an enquiry held with the view to dealing with the allegation of widespread corruption permeating the departments connected with the scheme? The public may wince, but it is to be hoped it will not allow considerations of further expense or a desire to shield the guilty to interfere with following the correct course on which it has embarked. The fullest exposure is being demanded as it is generally desired to effect some amelioration of the obviously dirty condition that certain spending agencies have descended to during the last decade especially. Publicity from the very initiation of such schemes as the Back Bay improvements to the spending of the last rupee and the closing of the accounts and completion report is what the taxpayer is entitled to demand.

Current News.

THE ports of Welshpool and Lake Entrance, Victoria, are to be developed at a cost of about £100,000.

THE death is announced of Professor Lorentz, the well-known scientist and Nobel prize winner in 1902.

THE Mining Department of the North Staffordshire Technical College is to be extended at a cost of £12,000.

AN effort is to be made to raise one of the Emperor Caligula's barges, which has lain at the bottom of Lake Nemi, near Rome, for some 1,900 years.

THE timber seam, which has been found at the Hook Colliery in the western part of Pembrokeshire, is 9 feet thick and provides some very good anthracite.

THE Buenos Aires Municipal Council has decided to reject the offer put forward by a London group, headed by Lord Ampthill, to construct an underground railway.

LAST year's revenue from the transit of ships through the Suez Canal amounted to 207,310,000f., as compared with 186,590,000f. in 1926, and 192,070,000f. in 1925. the previous record year.

THE first underground railway in the Far East was opened in Tokio on the 30th December. It has been constructed on the pattern of the New York subway, and is to be earthquake-proof.

THE International Astronomical Congress, which is to be held in Leiden during the coming summer, will be officially opened, in the Knight's Hall at The Hague, on the afternoon of 5th July.

THE total approximate gross earnings of State Railways up to 21st January amounted to Rs. 81·37 crores, or Rs. 373 lakhs more than the figures for the corresponding period of the previous year.

THE extension of railway accommodation from the Kenya-Uganda frontier at Tororo to Jinja on Lake Victoria was opened on 11th January and thus Uganda was given railway communication throughout to the coast.

THE total approximate gross earnings of State Railways for the week ending 21st January amounted to Rs. 220 lakhs, Rs. 1 lakh more than the figures for the last week, and Rs. 8 lakhs more than the figures for the corresponding week of the previous year.

MR. J. H. FYFE, of Messrs. Mackinnon, Mackenzie and Co., has been elected a representative of the Bengal Chamber of Commerce on the Calcutta Port Commission, *vice* Sir John Bell, of the same firm, whose term of office expires on 22nd February.

ACCORDING to the Dominion Bureau of Statistics at Ottawa, automobile parts and accessories manufactured in Canada during 1926 reached a total value of 13,914.965 dollars, an increase of 24 per cent. over the 11,234,828 dollars reported for the previous year.

MR. H. N. PARKER, District Traffic Superintendent, Commercial, E. B. Railway, Calcutta, has succeeded Mr. I. T. St. Clair Pringle, Assistant Agent, who has been transferred to the office of the Railway Board. Mr. Parker has been succeeded by Mr. V. P. Bhandarkar.

THE front of the Metropolitan District Station at Mansion House, London, is to be modernised. It will be rebuilt in Portland stone. The stations at Blackfriars, Temple, Westminster and Victoria have already been dealt with, and Charing Cross, St. James' Park and West Kensington are in hand.

PRELIMINARY discussions have taken place in respect of an American loan for the Ruhr collieries, which would be chiefly devoted to the building of workmen's dwellings. Nothing definite has yet become known, but the sum of $13,000,000 is mentioned, and the Deutsche Bank is said to be acting as intermediary.

THE existing railways of Iraq comprise 186 miles of 4 feet 8½-inch gauge and 624 miles of metre gauge. The only railway in the country before the war was the 74 miles long, 4 feet 8½-inch gauge line between Baghdad and Samarrah. Brigadier-General Hammond's report on the railways of Iraq has just been published.

THERE was a large gathering at Athens on 8th January to witness the laying of the foundation stone for the new underground station of the electric railway that is being built from the port of Piræus to Athens and up to Kephisia, by an Anglo-Greek company under the auspices of a London company and the National Bank of Athens.

MR. P. PARROTT, M. L. C., of Messrs. Kilburn and Co., has been elected a representative of the Bengal Chamber of Commerce on the Calcutta Port Commission, *vice* Mr. J. Y. Philip, of Messrs. Macneill and Co., who has been granted permission to be absent from the Commissioners' meetings for nine months and ten days with effect from 11th February.

IN Great Britain there are 20,400 route-miles of line, representing about 23 miles for every 100 square miles of area and 4½ miles for every 10,000 inhabitants. The United States has 251,000 miles of railway, or one-third of the world's railway mileage. This represents 7 miles to 100 square miles of territory and 24 miles for every 10,000 inhabitants.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

"STONEY" GATES FOR SUKKUR BARRAGE.

SIR,—Messrs. Ransomes and Rapier, Ltd., have secured the contract for the construction and complete erection of 66 "Stoney" Gates, each of 60 feet span for the Sukkur Barrage. The gates will be of the "two-girder" principle and will embody all the latest features in barrage gate design.

If the piers to receive the gates are not yet being built, is it not a bit previous to be getting the gates out now? However, even if the barrage is found to be not required at Sukkur and it is decided to have one where it will be useful—at Kashmor—the gates can be moved up and re-erected, after the present generation has had its innings at Sukkur?

FAS AUT NEFAS.

THE HIGH COST OF ROADS.

SIR,—The issue between roads and traffic reminds the engineer of the never-ending struggle between armour-plating and guns. To my mind it is in civil affairs an useless waste of money. Why should not the vehicle be studied as closely as the road, loads and impacts reduced in reason, and the road-user compelled to pay for undue damage? Do railway engineers design bridges and permanent ways in order to permit the locomotive and wagon departments to do all they know to hammer and overstrain at will? As a matter of commonsense why should road engineers be obliged to build and repair to take any destructive vehicle the motor manufacturer elects to run upon a public highway?

Σ. Φ.

16th January 1928.

Literary Notices.

Railway Signalling: Theory and Practice.—A practical manual for engineers, transportation officers and students. By S. T. Dutton, M. Inst. C. E., Late Deputy Chief Engineer, East Indian Railway. London: Crosby Lockwood and Son, Stationers' Hall Court, Ludgate Hill, E. C. 4. 1928. Price 7*s*. 6*d*. net.

This book is one of Lockwood's series of Manuals and is of considerable value to those connected with railways. The author writes in his preface:—The need for a thoroughly sound and practical book on the subject of Railway Signalling has long been felt, and it has been the aim of the author, as the result of many years of railway experience, to supply the want. The subject has been treated throughout in a practical manner and the illustrations have been selected for their practical utility in illustrating the particular point under examination. The text is clear and concise, and the book has been written to serve both as a text-book and as a work of reference.

The Water Supply of Towns and the Construction of Waterworks.—A practical treatise for the use of engineers and students of engineering. By W K. Burton, Assoc. M. Inst. C. E., Late Professor of Sanitary Engineering in the Imperial University, Tokio, Japan, Sanitary Engineer to the Home Department, Japan. Fourth Edition. In two volumes. Vol. I. Collection and Purification Works. Vol. II. Works for Distribution. By J. E. Dumbleton, Assoc. M. Inst. C. E., Author of "Wells and Boreholes for Water Supply." With numerous plates and other illustrations. London: Crosby Lockwood and Son, Stationers' Hall Court, Ludgate Hill, E. C. 4. 1928. Price, 25*s*. per volume.

These two volumes will prove of very great interest and value to all engineers who are interested in the construction of waterworks. Mr. J. E. Dumbleton, the Editor, in his preface to this, the fourth edition, writes:—In reviewing a book which has been written by such an authority on water supply as Mr. Burton, it is necessary that the utmost care shall be taken to preserve the character of the original work and at the same time to embody the many improvements in detail which have resulted from numerous discoveries and inventions during recent years. These two essential principles form the basis upon which this edition has been prepared, and alterations and additions have only been made where the context of the last edition was obviously at variance with modern practice. Although it is considered expedient to publish this edition in two volumes, the sequence conforms to that of the last edition except that certain passages have been transposed and amplified so that as far as possible information on the same subject shall be collated.

Foreign Notes.

Alumina Cement for Concrete Pipes.—Tests carried out in the States with a view to determining the effect of alumina cement in the case of concrete pipes gave some interesting results. In one case a 54-inch pipe made of the standard concrete for this type of pipe, using alumina cement instead of Portland cement, was tested at the age of 24 hours. The pipe stood a total load in pounds under the standard pipe test of 38,510 lb.. with only a few cracks which were not all the way through the walls of the pipe. The required load for a 20-day old concrete pipe with Portland cement was 38,400 lb.

A Cantilever Bridge.—A bridge is being built over the Seine between Charenton and Ivry, just below the junction of that river with the Marne, for the purpose of carrying the cables of the Metropolitan Railway and of the Paris electricity company and the Electricité de la Seine, which are defraying the cost. It will be open to pedestrians, but will have no vehicular traffic. It rests upon two piers, each composed of two armoured concrete caissons, inside of which are driven concrete piles 15 m. to 17 m. long. The central arch has a span of 134 m. and each half span is balanced by the weight of the short end. The bridge will carry two layers of three conduits for the cables.

Mono-rail Traffic.—A few years ago a proposal was made, and approved of officially, for installing a mono-rail on standards from which public service vehicles would be suspended and propelled by air screws between Paris and St. Denis. The journey would occupy about two minutes. It was regarded as the only means of relieving the traffic congestion of a particularly densely populated suburb. The scheme is still under consideration, and there appears some prospect of its being eventually realised as an experiment, doubtless in a modified form. General Hirschauer has now presented a more ambitious scheme, which aims at sending letters and parcels from Paris to Marseilles in a little more than two hours. Trolleys would run on electric cables carried by standards 10 m. high and would travel at a speed of 250 miles an hour.

Port of Marseilles.—A plan for carrying out further extensive works to the Port of Marseilles has been proposed in the hope that it will be possible to put them in hand at once with the aid of material supplied by Germany on account of reparations. The scheme provides for an enlargement of the old Jolliette basin by about two-thirds of its present area, by the construction of three moles which will provide accommodation for fifteen steamers. The new Pharo basin will be started upon, and its construction is expected to occupy from ten to fifteen years. Other important harbour works will also be put in hand at Marseilles, and at Port de Bouc the rocks at the entrance will be removed, while the dredging of a channel in the Etang de Berre, the building of docks on the south side of the Caronte, the purchase of a floating dock and other operations will complete the programme for connecting Marseilles up with the Rhone, and for providing extensive docking and anchoring facilities in the Caronte and the Etang de Berre.

Illumination by Fluorescence.—In connection with the Associated Edison Illuminating Companies' Convention at Colorado Springs, a spectacular method of illumination was shown. The sunken garden of the Broadmoor Hotel was flooded with invisible ultra-violet rays from quartz-tube mercury-vapour lamps fitted with powerful reflectors. The light was filtered through special lenses made of Corning glass, which obstructs all the visible light; it also prevents the band of short-wave energy deleterious to the eye-sight from passing through. As silvered glass reflectors absorb ultra-voilet rays, it was found necessary to make the reflectors of polished aluminium. The flowers, shrubbery, and ever-greens were sprayed with chemicals which fluoresced under the ultra-violet rays. The chemicals used were zinc sulphide, eosin, and rhodamine. Each individual leaf, twig, or flower glowed in various colours. The water in the fountain in the centre of the garden was also treated with fluorescent chemicals so that it became brilliantly luminous when the rays fell on it.

Flood Protection Works.—A report upon the works carried out by the Municipal Council for the protection of Paris after the disastrous inundation of 1910 shows that the total expenditure down to 1927 was 80 million francs. The urgent works being continued or to be put in hand, consisting largely of collectors in Paris and the suburbs, are estimated to cost another 80 million francs, and following upon these works others will have to be carried out at a cost of 26 million francs. While most prominence is given to the raising of embankments and the rapid discharge of flood water by collectors and mains, there is a vast programme for deepening the Seine and removing obstacles which will take many years to carry out, and this is not included in the above estimated cost. The dredging of the river below Paris is being continued, and an unusual undertaking is the removal of a large island outside the city, which at present divides the river in two narrow arms. The construction of barrage-reservoirs at a cost of 85 million francs is also intended to lessen the risk of floods.

Metal Tiles for Ceilings.—Perforated metal tiles, each backed with a 1-inch thick absorbent material, are being produced by the C. F. Burgess Laboratories, Inc., Madison, Wis., U. S. A., for ceilings for the purpose of reducing noise in factories and offices. They are known as Burgess Sanacoustic tiles. Their advantages are that they are non-combustible; dust or dirt can be sponged or scoured off the surface without in any way harming the absorbent or the artistic effect of the original application; they can be repainted and redecorated indefinitely, without reducing the absorbent factor noticeably; and they can be taken down and salvaged, or, if desired, removed to another room. To install the tiles it is necessary to fasten light metal clamp-strips to the ceiling on 16-inch centres. Into these strips are inserted the 16-inch by 16-inch perforated metal tiles, each one of which locks automatically into position. Either a metal, light wood or plaster moulding can be used to finish off the edges, and to blend into the wall surfaces or the remainder of the ceiling as the case may be. Any decoration, such as flat finish or stencil work, may be applied. Sanacoustic tiles are made with either a bevelled or plain squared edge.

Railway Labour in Japan.—Our contemporary, "The Railway Review," gives some interesting information regarding labour conditions on the Japanese railways. The hours of labour of the station staff, it is stated, range from nine hours a day to as much as 14 hours a day for night duty, the longer periods being largely of the "stand-by" order. Maintenance staffs work nine hours in the winter months, 10 in the spring and autumn, and 11 in the summer. Shopmen's hours are 10 per day from 7 A. M. to 5 P. M., with 40 minutes mid-day interval. Drivers and firemen are on duty just under eight hours per day, but the actual hours of driving are much less. Brakesmen work about eight hours per day. There is no Sunday rest in Japan, but most railway employees are granted one day a fortnight, though some get 24 hours off duty every four or five days. The practice is to pay wages monthly, the lowest-paid workers being women, who receive 24·93 yen (46*s.*) a month, with men on a higher scale. The lower grades are paid for all overtime worked, and receive extra grades after five years' service.

The Trans-Saharan Railway.—According to the "Railway Gazette," it is reported from Paris that the French Cabinet has finally approved of the construction of the long-projected railway across the Sahara Desert. This would link up Northern Africa with French Sudan and West Africa, and its completion would be of immense importance to French interests, as the journey time between Marseilles and the centre of Senegal would be reduced from 30 to 5 days. In French West and Equatorial Africa there are now close upon 3,000 miles of line, mainly on the metre gauge, and with the projected extensions of the Senegal, Guinea, Ivory Coast and Dahomey systems, an admirable network of railways is being developed. A further survey of the route of the proposed line is to be made, but it is probable that this will run south-west from Oran and then almost due south to Bourem and Ouagadougou. The railway will be about 2,000 miles long. Great possibilities are opened out as the result of the completion of such a line, especially if an extension is run out from Bourem to the north of Nigeria and down to the Belgian Congo. With the developments in other territories which are leading to improved connections with the Belgian systems, the French Trans-African railway would thus become the spinal column of the whole African system.

The Lentz Engined Cargo Steamer "Holystone."—According to "The Engineer," the cargo steamer "Holystone," which was built by Short Brothers, Ltd., of Sunderland, to the order of Common Brothers, of Newcastle-upon-Tyne, for the service of the Northumbrian Steam Shipping Company, Ltd., is of especial interest, as she is the first steamer to be propelled by a British-built Lentz type marine steam engine. It was built by John Dickinson and Sons, Ltd, of Sunderland, and has a designed output of 1,700 i. h. p. at 70 r. p. m. A double compound arrangement of cylinders is used, there being two 20½-inch diameter high-pressure cylinders and two 43⅜-inch diameter low-pressure cylinders with a common stroke of 43⅜-inch. The inlet and exhaust valves are of the Lentz poppet pattern. Steam at a total superheated temperature of 620 degrees Fahr. and a working pressure of 220 lb. per square inch is supplied by two multitubular boilers working under natural draught. The "Holystone" has a designed deadweight carrying capacity of about 9,000 tons and her extreme dimensions are 410 feet in length and 54 feet in breadth, with a depth moulded of 31 feet 6 inches. Very complete cargo discharging equipment is fitted and the holds are specially arranged for the carriage of grain in bulk. It is understood that the engine builders will give further particulars of the performance of the ship after she has returned from her first voyage.

California's Steam Wells.—Steam wells, where the earth is tapped for natural heat as it is elsewhere for natural gas or oil, promise to deliver power in paying quantities. The first development of this kind in America, at "The Geysers" in California, has been given a thorough scientific examination by Dr. E. T. Allen and Dr. A. L. Day, of the Carnegie Institution of Washington, and their report has recently been made public. The steam well region is in a little valley in the Coast Range, near San Francisco. There seems to be abundant steam at high temperatures and pressures when the borings are sunk. Eight wells have been bored so far, to depths of between 200 and 650 feet. These develop steam pressures between 60 and 275 pounds per square inch. Quantitative measurements of the output of four of the wells indicate a total power equivalent to 4,500 kilowatts. In spite of the borings, no diminution of steam flow at the natural fumaroles in the valley has been noted. Neither do the wells seem to diminish each other's activity, although two of them are within 50 feet of each other. A similar enterprise on a larger scale is in existence at Larderello, Italy, where the commercial production of power has already been realised. The California development has one advantage over the Italian wells, in that the Larderello steam contains corrosive acids, which necessitates more or less elaborate purifying processes before it can be used, whereas the California wells yield a steam whose acidity is so low that it can be used in its natural state.

Arc-Welding Rail-Joints.—Oxy-acetylene welding of worn rail-joints in position has been widely practised for some time in America, but latterly, according to our contemporay, "Railway Engineering and Maintenance," electric arc-welding is being used on railways in the Western States with good results. The complete outfit travels on the rails and has transverse wheels for removing it to the side of the track on a small platform built of ties at the site of operations. The main welding unit consists of a 40-h.-p. four-cylinder engine directly connected through a clutch to a 250 ampere welding generator with a specially designed grinding generator and exciter directly connected to the extended shaft of the welding generator by flexible couplings. Since July 1924 the welding company has restored nearly 150,000 joints; all the joints were ground to the true section of the rail and left in as good condition as when new. The advantages claimed for the welding process are that the welding heat is localised and there is no softening of the rail-ends, long defects may be corrected as the head is confined to the extreme upper surface of the rail, there is no chipping or spalling of the added metal, the full section of the rail is restored for the length of the angle bar by surface-grinding, compression fractures are prevented by cross-grinding the end of the joint, the flow of metal at the ends of the rail is reduced to a minimum, and the cost per unit of area welded is less than heretofore. The process has also been used successfully in the building-up of manganese crossings.

General Articles.

NEW PACIFIC TYPE LOCOMOTIVES FOR INDIA.

THE Vulcan Foundry Limited, of Newton-le-Willows, have recently completed a new series of 4-6-2 type passenger locomotives for service on the East Indian, Eastern Bengal and Great Indian Peninsula Railways. These new engines, which are officially classified as the XB class, conform to a new standard, and have been built to the designs and under the inspection of the Consulting Engineers, Messrs. Rendel, Palmer and Tritton, of Westminster.

The cylinders are placed outside the frames with steam chests and piston valves above them. The connecting rods engage with crank pins in the middle pair of coupled wheels, and Walschaerts gearing is employed for actuating the valves. The boiler is of large proportions, and the salient feature of the design is the wide firebox and large grate area adapted for burning low-grade fuel.

The following are the main particulars :—

Cylinders, diam.	21½ in.
,, stroke	28 in.
Piston valves, diam.	12 in.
Wheels, coupled, diam.	6 ft. 2 in.
,, bogie, leading	3 ft. 0 in.
,, ,, trailing	3 ft. 7 in.
Wheelbase, rigid	13 ft. 2 in.
,, engine	33 ft. 7 in.
,, total engine and tender	66 ft. 7½ in.
Boiler, working pressure	180 lb. per sq. in.
Heating surface—	
Firebox	198 sq. ft.
Tubes	1,642 sq. ft.
Total	1,840 sq. ft.
Superheater	463 sq. ft.
Combined total	2,303 sq. ft.
Grate area	45 sq. ft.
Weight on coupled wheels in working order	51 tons.
,, ,, leading bogie ,, ,,	22½ tons.
,, ,, trailing ,, ,, ,,	16¾ tons.
Total	90¼ tons

Each of these engines develops a tractive effort, at 90 per cent. boiler pressure, of 28,335 lb., ratio of adhesion at 90 per cent. 4.

The tender, which is carried upon six wheels, has outside framing, the wheels having a diameter of 3 feet 7 inches. The tank capacity is 4,500 gallons and fuel capacity 10 tons of coal. The tender in working order weighs 65 tons, thus bringing the total of engine and tender loaded to 155¼ tons. The equipment of the locomotives includes Ross pop safety valves, Owen balanced regulators, Evrit blow-off cocks, blow-down valves and drifting valves. The function of these latter is to enable the supply of steam to be taken from the steam stand on top of the firebox direct to the cylinder steam pipes close to the oil inlet from the lubricator, so that the efficient lubrication of the cylinders is continued while the engine is drifting. Balanced type injector steam valves are fitted, and also flexible water-space stays in the breaking zone. The piston valves are fitted with No Wear restrained piston rings, and Hendrie bye-pass valves are employed. The main pistons are of cast-steel box pattern with cast-iron periphery, and cast-iron metallic packing, supplied by the British Metallic Packing Company, is used for the piston rod glands.

Other fittings include Lambert wet sanding, National friction draught gear, and Goodall articulated drawbar between engine and tender. Three different types of blowers are fitted, namely, "Diamond," "Perry" and "Clyde," and each of the railways is receiving a certain number of engines equipped with each type of blower, the idea being to test the efficiencies of the different blowers with a view to the adoption of one particular type as a future standard. Heat-resisting alloy steel firedoors are used, these being of two makes, *viz.* :—"Staybrite," supplied by Firths, and "Vickro," by Vickers Limited, a certain number of each make being sent to each administration with a view to a comparative test. The East Indian Railway and Great Indian Peninsula Railway engines are being fitted with Sunbeam, and the Eastern Bengal with Pyle electric lighting equipment.

The following items are fitted to certain engines only, namely :—Blast pipe anti-vacuum jet, this being fitted to one engine for each railway. The function of this is to counteract the tendency for ashes to be drawn down the blast pipe when the engine is drifting with regulator closed. Cast-iron motion bushes are fitted to one engine for each railway instead of phosphor-bronze, also for trial purposes. The Franklin system of grease lubrication for the coupled axle-boxes is being fitted throughout on the G. I. P. engines and on one engine for the Eastern Bengal Railway. The "Henry" system of grease lubrication for the coupling and connecting rods is being fitted to one engine for the Eastern Bengal Railway and one for the Great Indian Peninsula Railway.

We are indebted to the "Railway Gazette" (London) for the illustrations on the opposite page and for the above description.

FACTORIZATION.

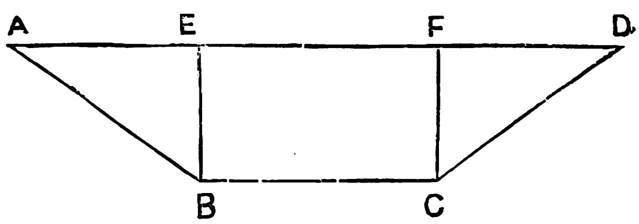
I.

ESTABLISHED methods and habits of thinking are hard to change ; and it is known to the writer that some difficulty is found with the factorized notation of the Σ. Φ. articles.

The Y-unit is primarily a measure of length, which by the national standards, varies in each application and is not a numerical constant for all possible applications, such as a standard yard or *metre* would be. Draughtsmanship offers an illustration. There might exist complete plans of two structures, the one structure in every part and detail the exact double in dimension of the other. In the drawings, instead of scaling off, it would be practicable to accept one important dimension as a Y-unit = 1·000, when every other dimension might be stated, for both designs, in terms of the unit, as *a* units, *b* units, etc. The Y-unit is therefore a constant measure of proportion, applied to a series of exactly similar designs, though not a *standard* unit of length. It expresses proportion, as if the above drawings were half-size and quarter-size, respectively, to compare with the object itself.

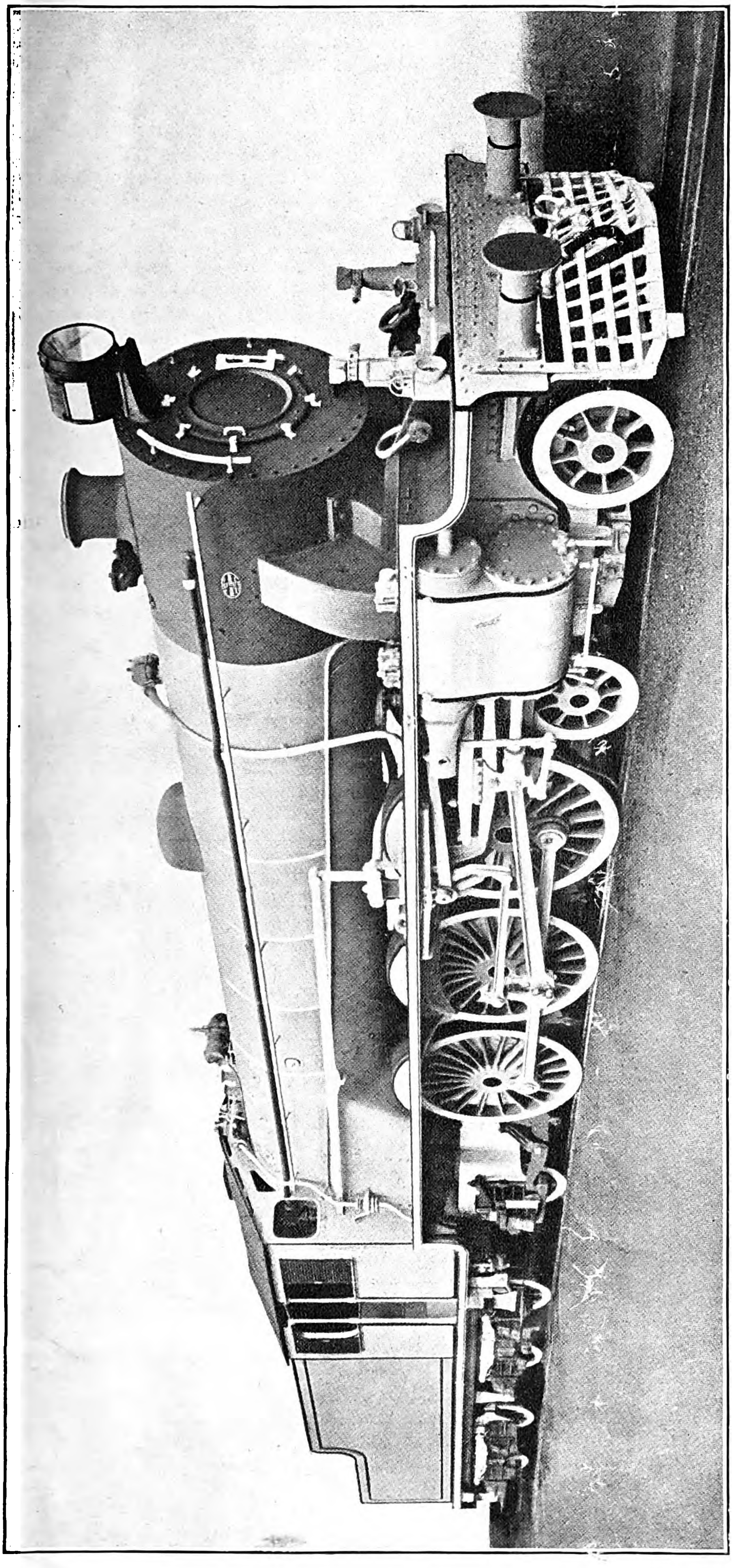
In the figure below, let ABCD represent the section of a newly-constructed canal, before water is

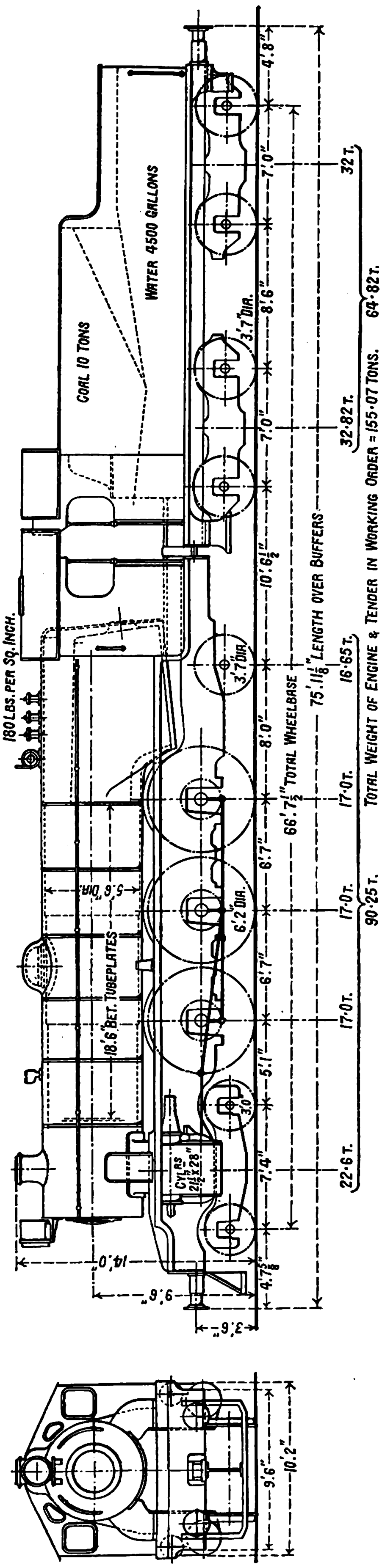
FIG. 1.



admitted. Suppose AD the future water-level, and the length AD itself the surface-width = S. Let BC, the bed-width = b ; and the side-slopes be denoted by the proportion AE : EB or FD : FC. Let EB = FC, = d, the depth of section across the bed-width BC.

In any canal system, where the side-slopes are more or less uniform, it is the practice to describe a canal by the proportion b/d, using d as a kind of Y-unit, but not employing it further than as above stated. The system





General View and Dimensioned Elevations of New XB Class Pacific Passenger Locomotives for Indian Railways.

NEW PACIFIC TYPE LOCOMOTIVES FOR INDIA.

of hydraulic factorization, completely re-introduced, in modern times, by the writer, employs the Y-unit dimensionally to classify all descriptions of channel, including those not trapezoidal or which have altered under the action of flow.

The method adopted assumes as the Y-unit, one-third of $d=y$, for the simple reason that employing the whole d is as troublesome in decimal fractions as using a yard or *metre* for a foot. The object is to reduce the factors in calculation to three reliable places of decimals only.*

Making the unit of length $\frac{1}{3}\, d=y$; $AD=S=Wy$; $BC=b=xy$; $AE=FD=ay$; and $BE=CF=d=3\ y$. Every regular section, as shown in the figure, can be dealt with in calculation and compared, in terms of W, x, a, and 3 (the *constant* depth). The method completely overcomes the difficulty of comparing observations in different systems of weight and measure.

If in design, x and a are always whole numbers, standardisation is easy, and y may vary to any desired extent. A Y-unit stick, given to every foreman of unskilled labour, is sufficient for illiteracy in draughtsmanship, and piece-work payments can be made in the Y-unit, at agreed rates calculated in the office.

The system aids hydraulic calculation and office design in a remarkable way. The hydraulic mean radius, m, may be written $f\,y$; and it is known that f applies to the units W, x, and a. All channels with constant units as above, possess the same f; and this connection can be shown to be of extraordinary importance in hydraulic calculation.

TABLE A.

No.	B E d	y	B C b	A E	f	m
1	3	1·00	30	5·00	2·520	2·52
2	4	1·33	40	6·67	,,	3·36
3	5	1·67	50	8·33	,,	4·20
4	6	2·00	60	10·00	,,	5·04
5	7	2·33	70	11·67	,,	5·88

In section No. 1, since $y=1$; $b=x=30$; $AE=ay=a=5$; $m=fy$ right through. Since the values of m might apply to innumerable channels of widely differing outline, it is obvious f is the only reliable connection, coupled with x and a, in the equation :—

$$f=\frac{3\,(x+a)}{x+q+a}.$$

All channels with equal f, x, and a, are precisely similar channels in hydraulics.

Further, without any equality in x or a, it can be shown that the same f_p also denotes equality in V_p, the critical mean *unit* velocity, when $V_o = V_p\sqrt{y}$.

These relationships cannot be shown by merely considering m, except in a very clumsy and roundabout way.

As regards f_p the reader will remember the explanation given in the articles "Factorized Hydraulic Formulæ" of the Pyramid Composite Section in which invariably :

$$f_p=\frac{3\,(x+5)}{x+12}$$

The PYRAMID KENNEDY FORMULA has been already mentioned in the "Notes and Comments" columns of INDIAN ENGINEERING, as :—

$$V_o = C_o \times \sqrt{f_p} \times \sqrt{y} = C_o\sqrt{m_p}$$

And, since $W = x + 2a$, if $a = 5$, then :

$$f_p=\frac{3\,(W-5)}{W+2}.$$

Applying this last equation to Robert Gordon's (1873) observations of the River Irawadi, at Saiktha, in Burma, the following curious relationships appear, which it can confidently be asserted, would show themselves by no other method. The V_o given in the table which follows have been calculated by assuming C_o to possess the tentative Burma value of 1·234, a value necessarily subject to check and probable correction and revision by the trained engineering staff dealing with the local problems in hydraulics. The inclusion of V_o implies that with these velocities the sections would scour out to "Kennedy" sections, with, of course, different L, to those shown.

* Ensuring a more full use of ordinary tables of logarithms.

TABLE B.

Ref. No.	Obs. v	d	S	i 0·0000...	f	m
3113	1·459	37	3,528	... 1291	1·421	17·52
3114	1·783	39	3,710	... 1722	1·422	18·49
3115	2·083	41	3,930	... 2152	1·457	19·88
3116	2·360	43	4,208	... 2583	1·395	19·99
3117	2·620	45	4,605	... 3013	1·360	20·40
3118	2·857	47	4,780	... 3444	1·349	21·13
3119	3·091	49	4,820	... 3874	1·406	22·97
3120	3·321	51	4,859	... 4304	1·453	24·70

Ref. No.	V_o	y	W	$\frac{l}{y}=L$	f_p	m_p
3113	7·413	12·33	286·1	6,282	2·927	36·10
3114	7·610	13·00	285·4	4,467	2·927	38·05
3115	7·803	13·67	287·6	3,399	2·927	40·00
3116	7·994	14·33	293·6	2,702	2·929	41·98
3117	8·182	15·00	307·0	2,213	2·932	43·98
3118	8·362	15·67	305·1	1,853	2·932	45·94
3119	8·533	16·33	295·1	1,581	2·929	47·84
3120	8·703	17·00	285·8	1,367	2·927	49·76

Σ. Φ.

24th December 1927.

THE WATERWAY OF BRIDGES AND CRAIG'S FORMULA.

[FROM A CORRESPONDENT.]

II.

MR. CRAIG stated "the *maximum rate of discharge*, cannot depend merely upon the extent of area, etc., but J. F. quotes Mr. Craig as follows :—"The maximum discharge cannot depend merely on the extent of catchment area, etc." A maximum rate of discharge involves a *time factor*, for it is, $\dfrac{\textit{a quantity in cubic feet say}}{\textit{time in seconds}}$;

and since time in seconds $=\dfrac{\textit{length in feet}}{\textit{velocity in feet per second}}$

therefore a rate of discharge is, a quantity in cubic feet multiplied by a mean velocity in feet per second and the resultant divided by a length in feet, *i. e.*, it is an area in square feet multiplied by a mean velocity in feet per second. Mr. Craig takes "two illustrative catchments, one rectangle on end and one on edge," each equal to one square mile in area, *i. e.*, *both of the same size;* but, so far as the "outfall," the same for each catchment area, is concerned, and especially so when considering the maximum rate of discharge at this locality, these two rectangles *are not of the same shape.* Mr. Craig makes this quite clear, when he states "*the mean distance* of the water being ½ mile from the point of discharge in the one case and ¼ mile in the other;" for, as we can clearly see, in arriving at a maximum *rate of discharge* at the outfall,

Mr. Craig takes into consideration the *mean distance* the water has to travel from off the catchment area; it is on *this distance* and the *time* taken to travel along it to the outfall, he arrives at the *mean velocity* of discharge.

In his para. 4, J. F. makes D (cusecs) = 440. B i v, and states that this is, "as was practically assumed by Craig to begin with:" but his value of B is not the same as that used by Craig when applying Craig's formula. Looking into Craig's solution, I find that he gives the discharge off FK (using J. F.'s figure and notation) as $440 \times c \times b \times v \times i \times \frac{dl}{l}$ cusecs and not (as given by J. F.) $= 440 \times b \times v \times i$; and the "rate of discharge from the whole basin in cusecs" $= 440 \times c \times b \times v \times i \int_0 \frac{dl}{l}$ [where b is the width of zone F K as in J. F.'s figure, and l is his l], and not $= 440 \times B \times v \times i$ (cusecs) as given by J. F. [in which B is the full width of the base, *i. e.*, the maximum width of the isosceles triangle]. The difference arises in this way, Craig takes * a coefficient C and multiplies it by the *quantity* (cubic feet) of water falling on the small zone FK, and divides the result by the *time* (secs.) $\left[\text{equal to } \frac{l}{v}\right]$. *this reduced quantity* takes to reach the point O (the outfall), v being the "mean velocity of the drainage from FK"† towards O; whereas J. F. takes an *area* $\left[\frac{5280 \text{ b i}}{12} = \text{square feet}\right]$ and multiplies it by a *mean velocity* in feet per second $\left[\text{which is } \frac{l}{t}\right]$ to get a rate of discharge in cusecs, as if he were dealing with the rate of discharge through a cross section of a canal; and omits entirely the factor C (the coefficient of runoff which depends on the natural characteristics of the catchment area). The result is that Craig's formula should be (using J. F.'s notation and giving the value of b (the mean width) $= \frac{B}{2}$, as in J. F.'s figure) D (cusecs) $= 440 \times c \times v \times i \int_0^L \frac{b\,dl}{l} = 440\, c\, v\, i \frac{B}{L} \int_0^L dl = 440\, c\, v\, i\, B$ $\left[\text{since if } b = \frac{B}{2}, l = \frac{L}{2}\right]$, but J. F.'s B in this result is equal to *twice* Craig's B! *Therefore J. F.'s values of A* (area of flood section) *are all are too great*, and in addition his factor f omits the very important "flood moderator," which is included in the coefficient C. Also his factor $f = i \log_e \frac{8\,L^2}{b}$. [where b is Craig's B = mean width of isosceles triangle $= \frac{1}{2}$ J. F.'s B] besides omitting C, the factor less than unity, which depends on many "flood moderators," met with on large catchment areas, should have the value $i \log_e (64 \sqrt{M})$ and not $i \log_e (32 \sqrt{M})$. J. F.'s value of A (area of maximum flood section) mile inches, introduces a new basis of measurement for the cross section of a river in flood to correspond with his unit for rate of flood discharge in * square mile inches per hour, which we are not accustomed to, and which tends to cause confusion. If you want the cross section in square feet, which is usual, you must multiply A by $\left(5280 \times \frac{1}{12}\right) = 440$; and if you require the rate of discharge in cusecs it is necessary to multiply square mile inch per hour by $\frac{5280 \times 5280}{12 \times 60 \times 60} = 645\frac{1}{3}$, and the result by the number of square miles of area.

Since Craig's FK = B is *the mean width of isosceles triangle*, which in J. F.'s figure is written b = FK, then J. F.'s $A = \frac{S}{440}$ (Craig's S) $= C \times b \times i \times \log_e \frac{8L^2}{b}$, and since mean width $b = \frac{B}{2}$ (see J. F.'s figure) $\therefore A = \frac{S}{440} = C \times \frac{B}{2} \times i \times \log_e \frac{8L^2}{b}$, and writing f for the factor † $C \times i \times \log_e \frac{8L^2}{b}$ (where b is Craig's B) we obtain $A = \frac{S}{440} = f \times \frac{B}{2}$ (J. F.'s value of B). From J. F.'s figure $B = \frac{2M}{L}$ (where M = area of triangle) and L is assumed by J. F. *to be ordinarily* = ‡ $2\sqrt{M}$, therefore $B = \sqrt{M}$, and we arrived at $A = f \times \frac{\sqrt{M}}{2}$, which is *half the value* § given by J. F., so that $f = \frac{2A}{\sqrt{M}}$ instead of J. F.'s value $\frac{A}{\sqrt{M}}$: and $f = c.\ i.\ \log_e (64\sqrt{M})$.

I cannot see that any useful information or reliable results can be obtained by the use of Craig's factor $\log_e \frac{8L^2}{B}$, which has been proved to be inaccurate and unreliable.

The following table of calculations should be compared with J. F.'s comparisons between his formula for A (mile inches) and Mr. Lillie's formula for S (square feet).

* C = the coefficient of discharge according to Craig and is less than unity, except for very small areas that are considered impervious after several days of rain.

† It is evident that Craig assumed FK to be a zone passing through the mean width of area, because he makes its width B equal to the mean width of the triangle, *i. e.*, half the width of J. F.'s base, which J. F. calls B miles.

* A unit much used in the U. S. A.

† $f = c.\ i.\ \log_e 64\sqrt{M}$ and not as J. F. has valued it.

‡ This is true in an isosceles triangle only when the base (B) is equal to half the height (L).

§ Therefore J. F.'s formula gives for the Adjai where M = 1,350 an area of flood section = 29,360, instead of half this, *viz.*, 14,680 square feet, which is Lillie's estimate.

Name of River and Locality.	S	A	M	$\sqrt{M}$	$\frac{A}{\sqrt{M}}$	$\frac{2A}{\sqrt{M}}$	$\frac{3}{M^{\cdot 07}}$	$2 \times \frac{3}{M^{\cdot 07}}$	log. $64\sqrt{M}$	Craig's P = c i.
Irrawaddy, Prome ...	205,617	467	128,000	358	1·304	2·608	1·3175	2·635	10·02814	0·26
Damodar, Raniganj ...	55,000	125	7,200	85	1·47	2·94	1·611	3·222	8·5919	0·34
Gunjal, G. I. P. Railway ...	23,600	54	706	27	2·0	4·0	1·8951	3·7902	7·4463	0·53
Sone at Dehri	136,000	309	26,450	163	1·9	3·8	1·4706	2·9412	9·24224	0·41
Sohan, Rawalpindi ..	10,000	23	576	24	0·96	1·92	1·9182	3·8364	7·3287	0·261
Kala Nadi, U. P. ...	23,325	53	2,660	51·57	1·027	2·054	1·7271	3·4542	8·0927	0·253
Adjai, E. I. Railway ...	20,000	45·45	1,350	36·74	1·237	2·474	1·81158	3·623	7·754	0·319
Ganges at Sara	254,750	579	365,000	604	0·958	1·916	1·224	2·448	10·5506	0·181
Sutlej at Adamwahan ...	Lillie 46,800	106·4	49,000	222	0·479	0·958	1·408	2·816	9·5508	0·1003

To obtain the value of Craig's $P = c\ i$, divide $\frac{2A}{\sqrt{M}} = f$, by $\log_e (64 \sqrt{M})$.

Craig assumed a constant value of $P = 0{\cdot}18$ "for India South of the Himalayas and for Burma so that for practical use in these countries" his equation for

$S = 80\ \Sigma\ B \log_e \frac{8\ L^2}{B} = 184\ \Sigma\ B \log_{10} \frac{8\ L^2}{B}$, where B = mean width of isosceles triangle and L = length of line joining the apex with centre of base line. The figures in the last column show that the values of $P = c\ i$ are very variable and that only in the case of the Ganges at Sara is $P = 0{\cdot}18$.

J. F.'s value of f should be $\frac{2A}{\sqrt{M}}$, or $f = c\ i \log_e (64\sqrt{M}) = 2{\cdot}3\ c\ i \log_{10} (64\sqrt{M})$.

THE INDUSTRIAL APPLICATION OF SURFACE COMBUSTION.

A MOST interesting article appeared in a recent issue of "The Engineer" (London), on the subject of the industrial application of Surface Combustion, as exemplified by the Cox system, which is controlled by the Metropolitan Fuel Co., Ltd., of Wood Street, Westminster, S. W. It is no exaggeration to say that a notice in the columns of such an authoritative journal as "The Engineer" confers something in the nature of a hallmark upon the product or system described, and the many applications of the Cox system will undoubtedly be watched with very considerable interest.

Referring to various examples of Cox's Ignite Combustors shown at the Shipping, Engineering and Machinery Exhibition in London, "The Engineer" says :—"It is over 16 years since Professor W. A. Bone drew attention in two Royal Institution lectures to his researches on surface combustion and to the possibilities of the application of the phenomenon in the arts. The commercial development of the scientific side of the subject suffered several checks and changes until the work was taken up by Mr. Cox and the Metropolitan Fuel Company. In the hands of that gentleman and that company, surface combustion has been brought to a sound stage of practical usefulness, and has been successfully applied to a large number of industrial ends.

Surface combustion was investigated over a hundred years ago by Sir Humphry Davy, and after him Dulong, Graham and Faraday discussed and studied it. It was well known to these early workers in the field that two gases could be caused to combine slowly and without the production of flame at temperatures below their normal temperature of ignition. In the presence of certain bodies, such as porous porcelain, magnesia, platinum, nickel, etc., the rate at which this sub-normal combustion proceeded became greatly enhanced. The acceleration of the rate of the sub-normal combustion was described as being due to a process of activation brought about by the porcelain, magnesia, nickel or other body. Professor Bone and his fellow-workers were responsible for the discovery that the activating properties of certain bodies were not confined to gases below the normal temperature of combustion, but that at temperatures above that point they continued to increase the normal rate of combustion and continued to preserve the flameless characteristic of the combustion. The phenomenon was demonstrated in 1911 by means of a box-like apparatus, one face of which was made of a porous fire-clay material. A combustible mixture of gas and air was delivered into the box. On applying a light to the porous face the issuing mixture inflamed. In a few seconds, however, the fire-clay became incandescent, and the flame disappeared. The fire-clay had reached the activating stage, the rate of combination of the two gases had been accentuated, and the combustion was proceeding flamelessly on the surface of the fire-clay face. In that state all the heat liberated was in the radiant form. To maintain the combustion in this condition, the inflammable mixture had to be delivered to the apparatus at a rate in excess of that at which the inflammation would pass backwards from the fire-clay face into the supply pipe.

We understand that much of the success which has attended Mr. Cox's development of Professor Bone's results turns upon the use of an improved form of porous material. The substance now employed is a hard granular fire-clay-like material that can be moulded into any desired form before it is fired. Close attention has been paid to the granulation of the material, and an essential feature is, we gather, that the granules should diminish in size towards the face on which the combustion is to take place.

It should be evident that surface combustion affords a means of heating which is exceptional in several respects. For example, the combustion is complete with the result that neither smoke nor objectionable fumes are produced, the only products in the case for ordinary combustible gases being water vapour and carbon dioxide. Again, the mixture supplied to the apparatus using surface combustion is complete in itself. It neither requires additional air nor carries with it air in excess of that just required for combustion. As a consequence, the atmosphere inside the apparatus is neither oxidising nor reducing, but neutral. This fact can be demonstrated by dropping a match stick into the interior of a surface combustion furnace. The wood will not ignite. Under the intense purely radiant heat it slowly changes to charcoal by parting with its volatiles. Although the minimum rate at which the mixture is delivered to the refractory body is set by the rate at which the flame will strike back into the supply, the normal rate of working is sufficiently far above the limit to provide a wide range of adjustment before the minimum is reached. The regulation of the heat emitted is therefore easy and can be made either instantaneous or graduated. It can, in addition, readily be achieved automatically, either under the control of a timing device or under that of a thermostat. The principle of surface combustion can be, and has been, applied not only to town gas, but to petrol-air gas, producer gas, oil gas, and so forth. As for its efficiency, it can be said that an independent test on a surface combustion water heater showed an efficiency under not too favourable circumstances of 93·6 per cent. reckoned on the net calorific value of the gas.

Of the applications of the surface combustion principle made by the Metropolitan Fuel Company, particulars we have received show that it is now in use in the manufacture of sweetmeats, for sugar boiling, biscuit baking, vermicelli and tobacco drying, and die casting, for cooking ovens, the heat treatment and melting of metals, for singeing and calendering textiles, for heating soldering baths, and for heating water and raising steam in boilers of the immersion type.

In some tests carried out at a Government Department on one of the company's heating furnaces, the object heated was a steel billet, 10 inches diameter by 10 inches long. Four thermo-couples were applied to the billet all in a plane 5 inches from one end. One of the couples was placed on the surface, one at the foot of a hole drilled down the centre of the billet, one in a hole at a radius of 2½ inches from the centre, and the fourth in a hole at a radius as near 5 inches as possible without breaking the surface of the billet. The results of this test show that all four thermo-couples registered a temperature of just over 1,000 degrees Cent. within 108 minutes of the furnace being lit up. The total gas consumption up to that instant was about 1,920 cubic feet."

CAST IRON WATER PIPES.

WATER is the most important and vital of our daily needs, and the most important service to any community is a pure and uncontaminated water supply, and in no way can the health of a town suffer so rapidly or so badly as when affected by a shortage, or a poor supply of water or by impure water. Uncleanliness, epidemics, deadly diseases follow one another in rapid succession. It is, therefore, imperative that the system of supply shall be, not the cheapest in first cost, which may be, and generally is, the weakest, nor the most insistently pressed, which may have its vices smothered in the loud-voiced proclamation of its virtues, though one can hardly expect an advertisement to shout the vices of the advertised article (even in these days of "truth in advertising"), in other words not the most widely advertised because a second-rate article may well serve the purpose of an elaborate advertising scheme by even a first-rate advertising agent and in this case time and experience alone can separate the truth from the "fairy tales," but the most satisfactory system is that which best meets the ordeal of close examination and which has the largest number of points to its credit.

There is no system of any other material that has the same number of points to its credit as British Standard cast iron pipes. One to two hundred years is quite a reasonable estimate to make with regard to the length of time of efficient and satisfactory service of cast iron pipes, these figures being amply supported by evidence throughout England and the Continent, and there are a number of cases of even these lengthy periods being greatly exceeded.

In the last few years great improvements have been effected in the manufacture of cast iron pipes. In all high-class pipes the composition of the pig iron used is under strict control and produces castings of predetermined composition to conform to a specification acceptable by all qualified engineers, and carefully tested under strenuous and difficult conditions. In fact, from actual working conditions, and many thousand different installations, the length of life of cast iron pipes is such that taking the widest possible survey, no wrought iron or steel tubes can be put in the slightest comparison with them.

In cast iron pipes a large factor of safety is always present and no Engineers can possibly have fears as to the measure of safety actually existing when dealing with cast iron pipes, particularly those to The British Standard Specification.

Cast iron pipes need no overcoat, as cast-iron is without a rival in its capacity to resist the attack of rust, and pipes laid 80 to 100 years ago with no protection whatever remain in continuous service, without material deterioration and are calculated to continue in efficient use for an indefinitely long period.

Steel rusts away or deteriorates at a rate approximately 33 per cent. faster than cast iron and as steel pipes are usually made about one-third or one-quarter the thickness of cast iron pipes, the superiority of cast iron pipes will be realised. And, then again, when corrosion starts on steel, it can never be satisfactorily stopped, whereas on cast iron corrosion or rust is very rarely found to have penetrated far below the surface.

Another charge sometimes levelled against cast iron pipes is that of internal deposit and the necessity for frequent scraping. The answer to this is that water that causes a deposit in cast iron pipes will cause a deposit in any pipe, be it made of steel, wrought iron, or anything else, and whether it is lined with concrete, bitumen or any other type of lining.

In this case the superiority of cast iron is evident, as owing to cast iron pipes being thicker and of robust construction, they can safely be subjected to repeated scraping without the slightest injury.

With regard to comparisons of first cost between cast iron and steel for pipework, there is always the factor of safety to be taken into consideration, whereas on cast iron pipes this figure varies from about 10 up to 20 in the smaller sizes, that for steel pipes will usually be found to be a fraction of this amount, the effect of this difference being such as to give, at first sight, a very misleading figure in favour of steel pipe, but, taking into consideration length of life, effective service and actual maintenance costs over the same period, the balance will be found to be very much in favour of cast iron.

The Gazettes.

Bihar and Orissa, February 1, 1928.

Public Works Department.

On return from leave, Mr. R. J. H. Hudson, Executive Engineer, is posted to the charge of the Muzaffarpur Division.

Punjab, February 3, 1928.

Buildings and Roads Branch.

On transfer from the Jail Subdivision of the Jail Provincial Division, which he left on 21st December 1927, Mr. K. C. Vaish, Temporary Assistant Engineer, joined and took over charge of the Sheikhupura Subdivision of the 3rd Lahore Provincial Division on 22nd December 1927 from Lala Guranditta Mal, Overseer.

On transfer from the Hissar Subdivision of the Ferozepore Provincial Division, which he left on 8th December 1927, Lala Sohan Lal Najjar, Assistant Engineer on probation, joined the Karnal Subdivision of the Ambala Provincial Division on 17th December 1927, and took over charge of the Subdivision on 21st December 1927 from M. Vidya Nand, Overseer.

On return from leave Pandit Ram Rakha Mal, Assistant Engineer, joined the Mianwali Subdivision of the Shahpur Provincial Division in the First Circle on 31st December 1927, and took over charge of the Subdivision on 3rd January 1928 from Mr. M. U. Q. Ahmady, Temporary Assistant Engineer, transferred.

On transfer from the Mianwali Subdivision of the Shahpur Provincial Division in the First Circle, which he left on 3rd January 1928, Mr. M. U. Q. Ahmady, Temporary Assistant Engineer, joined the Plan Checking Subdivision of the Jullundur Provincial Division in the Second Circle on 6th January 1928, and took over charge of the Subdivision on 9th January 1928.

Irrigation Branch.

Mr. L. Hammond, Assistant Engineer, on transfer from the Khadir Division, 2nd British Circle, Sutlej Valley Project, which he left on 5th January 1928, took over charge of the Islam Division, 3rd British Circle, Sutlej Valley Project, on the 8th idem, from Lala Radha Kishan Gupta, Assistant Executive Engineer.

Mr. E. L. Protheroe, Executive Engineer, on transfer from the Islam Division, 3rd British Circle, Sutlej Valley Project, which he left on 24th December 1927, took over charge of the Khadir Division, 2nd British Circle, Sutlej Valley Project, on 5th January 1928, from Mr. L. Hammond, Assistant Engineer.

Mr. H. W. King, Superintending Engineer, on return from leave resumed charge of the Lower Chenab West Circle of Superintendence on 17th January 1928, from Rai Bahadur Lala Wazir Chand Chopra, Superintending Engineer, transferred.

Rai Bahadur Lala Wazir Chand Chopra, Superintending Engineer, on transfer from the Lower Chenab West Circle, which he left on 17th January 1928, took over charge of the Lower Chenab East Circle on the same date from Mr. R. A. Routh, transferred.

Rai Bahadur Lala Hukam Chand, Executive Engineer, on transfer from the Burala Division, Lower Chenab East Circle, which he left on 16th January 1928, took over charge of the Lower Gugera Division, Lower Chenab East Circle, on the same date, from Sheikh Muhammad Shariff, Assistant Executive Engineer, transferred.

Mr. R. A. Routh, Executive Engineer, on transfer from the Lower Chenab East Circle, which he left on 17th January 1928, took over charge of the Burala Division, Lower Chenab East Circle, on the same date from Rai Bahadur Lala Hukam Chand, Executive Engineer, transferred.

Notice.

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CONTENTS

INDIAN ENGINEERING.

SATURDAY, FEBRUARY 18, 1928.

SIR WILLIAM WILLCOCKS, K. C. M. G.

III.

ON leaving Government service Sir William Willcocks joined the Cairo Water Company as Manager, and for the Company prepared the project for the drainage of Cairo. In 1899, on the invitation of Sir Ernest Cassel, he became the Managing Director of the Daira Sanieh Company; and in 1902 accompanied Sir Ernest on a visit to the Sudan, and at his request made proposals for various works, which Sir Ernest wished to carry out at his own expense and to present to the Government. The offer was not accepted, and Sir Ernest never went to the Sudan again. But Sir William Willcocks visited the Sudan on three subsequent occasions, and studied further the irrigation and other conditions of the province. On his second visit in 1908 he travelled up the White Nile to the Equator, where he nearly died of blood poisoning, and on his return delivered two lectures in Cairo on the reservoirs he prepared. On the third occasion in 1912, examining both the Blue Nile and the White, he prepared a preliminary project for the Sennar weir and the Gezereh Canal for the Inspector of Irrigation in the Sudan on lines approved by Lord Kitchener; and he paid his fourth and last visit to the Sudan up to latitude 5 in 1918, and incidentally witnessed one of the extraordinary floods in the White Nile which occur perhaps once in half a century. Sir William Willcocks, when it was his business to see anything, generally saw with his eyes very wide open, and in the course of his four visits to the Sudan formed his views on the requirements of the country. He is opposed to the Sennar or Makwar dam and canal on the Blue Nile, and prefers the original project of 1912, which he prepared on Lord Kitchener's terms that it should cost one to two millions sterling, to the existing project estimated at thirteen millions. He considers that the rock at Makwar is unsuited to the construction of big reservoir dams, the Aswan type of dam too expensive in interest and maintenance charges for a poor country like the Sudan, and the soil unsuited to irrigation from large canals causing infiltration. He begged the authorities to turn their attention to railways and drinking water supplies, and to try pumps on the White Nile, instead of embarking on the present scheme, and he holds that Egypt need have no anxiety about the Makwar dam and canal as they carry within them the seeds of their own undoing. It now remains for time to show whether he was right or not.

In between the Sudan trips, Sir William was doing other things. In 1901, while still Managing Director of the Daira Sanieh Company, he spent about three months

in South Africa in order to report to Lord Milner on the irrigation possibilities of the country, and subsequently wrote a blue book, "Affairs in South Africa," on the subject, as well as delivering a lecture at Cairo on his observations during the visit. Between 1905 and 1909 he practised as a consulting engineer and agricultural expert, and in 1909 was appointed Adviser to the Turkish Ministry of Public Works, a feature of his career to which we shall presently refer to again. In 1912 he toured in Canada to see the irrigation canals of the Dominion. In 1913 he reported on the irrigation and power possibilities on the Jordan for the Amirs Lutfulla of Cairo. In 1914 he visited the irrigation works of the United States as the guest of the American Government, and lectured to the engineers at Pittsburgh. In 1915 he inspected and reported on the potentialities of irrigation in Roumania for the Roumanian Government, just before Bulgaria entered the war. It was also in that year, shortly after Turkey had declared war, that he informed the General Commanding at Cairo that to the east of the Suez Canal, between Kantara and Port Said, there lay an extensive triangle of dry land below sea level, into which the sea could be cut, and the Suez Canal protected from the Turks. He suggested further that if the Turks were enticed into this low basin, they might be drowned out, as Moses drowned Pharaoh's army in days of old. The General had the water cut into the basin, but otherwise attempted no heroic tactics.

Reverting to Sir William's employment by the Turkish Government, when the Young Turks came into power in 1908, Kiamil Pasha, the Grand Vizier, summoned Sir William to Constantinople and entrusted him with the preparation of a project for the restoration of the ancient irrigation works of Mesopotamia. Accordingly, he started in November 1908 with a large staff of engineers, and by the end of April 1911 the whole project (report, maps and estimates) was completed, Sir William also commenced the construction of the Hindia barrage on the Euphrates, which Sir John Jackson subsequently finished. He left the service of Turkey after two and a half years, although he had a five years' contract with the Government and the Minister of Public Works did not wish him to go, because the difficulties owing to interference and harassments were so systematic and incessant. The project was a splendid piece of work, with the title of "The Irrigation of Mesopotamia" it has been published in book form by Messrs. E. and F. N. Spon of London, and when Sir William was invited to undertake the task he no doubt accepted it with the enthusiasm of the enthusiastic irrigation engineer he was. But to carry out work under the conditions of Turkish misrule was another affair, it was enough to break the heart of any engineer, and Sir William has told the story of his experiences in the March 1916 number of "Blackwood" in a very graphic piece of writing. Mesopotamia then belonged to Turkey, but in it the Turk was a stranger, hating the country and the country hating him. There were not fifteen hundred resident Turks in the whole Tigris-Euphrates delta. The Arabs were treacherous and suspicious, every man carried a gun, it was cheaper to buy guns and ammunition than to pay taxes. The man who held the levelling staff had a gun slung over his shoulder, which the engineer saw through his telescope every time he took an observation, while the man whose earthwork had to be measured stalked the engineer with his gun. There were frequent frays, always there was trouble over the money supplies, and altogether, in the peculiar circumstances of that time, matters were so impossible that it is small wonder that Sir William Willcocks threw up his brief.

In the later years of his life he occupied much of his time in translating the Gospels and Scriptures and in having his translations printed into books in the vernacular of Egypt by the ten thousand. He is a good linguist both in the vernacular (Punic) and the literary (Arabic) language of the country which he had made his home. He has an unusual knowledge of Scripture and Biblical history, in 1922 he took Sadhu Sundar Singh over the Holy Land, and his book, "From the Garden of Eden to the Crossing of the Jordan," throws light on points of Old Testament history which have puzzled many readers. His literary style has quite a flavour of its own, without any grace of diction it is very distinctive, as if he liked his language neat and did not want to drown the taste of it by diluting it with verbiage. And that was characteristic of him; one of those men who think things and do things, his creative instinct led him when he had a message to deliver to speak with no uncertain sound. People, who admitted that he was a genius, would sometimes qualify the remark by fearing that he was a visionary. So he was, but not because he indulged in fanciful theories, it was only that his range of vision was so much greater than that of mediocrities with their purblind eyes. In any case, he proved himself to be a great engineer, and irrigation engineers in India, where he was born and educated and whence he emerged into the light that was thrown on Egypt by the triumphs of engineers drawn from India during the time of the British occupation, will be proud of him, as one of themselves, and of all that he was able to accomplish in his busy life.

PULVERISED FUEL.

In our article on the Future of Coal, mention was made of Mr. Frank Hodges' optimistic predictions as regarding the future use of coal. Coal would be forced to yield the oil and gas that it contains for purposes of power, and the residual fuel in a pulverised form would be used as raw coal is used now, and especially as bunker fuel. By such means, Mr. Hodges foresaw an era of new prosperity for the coal industry such as had never been witnessed before. In that connexion, our notice has been drawn to a paper on "Pulverised Fuel for Marine Purposes," by Engineer-Captain J. C. Brand, R. A. N., which was read before the Institution of Naval Architects last July. In this paper the types of

fuel suitable for pulverisation were indicated, and the effect of grinding, pre-heating, etc., was discussed. Details were given of a successful system evolved in Australia for bunkering, unbunkering and burning powdered fuel in Scotch boilers, with particulars of tests with the plant, and comments on the economic possibilities of burning pulverised fuel on boardship, the problem of ash, and the absorption of moisture by powdered fuel. If therefore Mr. Hodges has been thought by some people to have been too cheerful in his outlook, it cannot be said that he had been seeing visions without some substantiality behind them. If the system has not yet arrived at a final stage of practice, it has at any rate received a good deal of experimental investigation, and has some promising features.

Pulverised fuel is a term used in the paper to include any carbonaceous fuel which is in a sufficiently divided state to be impelled by or borne in the air, and burned whilst in a state of suspension. Since such fuel to be ground is reduced in size by mechanical effort, it is obviously more economical to grind slack or breeze than larger pieces; and this is remunerative not only mechanically, but also financially. Small fuel is of less value than larger sizes which have a wider market. In Great Britain, to a very great extent, the manufacturing position has been bound up with the ability to develop and utilise economically the important raw product—coal. But for various reasons, which need not be entered into again, the coal industry has in recent years been assailed very seriously. Oil, commercially foreign to Britain, is a rival. Petrol engines, Diesel engines and oil-fuel burners have made steady inroads on a supremacy hitherto unchallenged. Fortunately, however, for the country, Captain Brand says, coal contains the vital elements of its rival, and the problem of how to reclaim them has engaged the investigations of leading scientists in the past decade. The competition of oil lead to this research, and Captain Brand continues to say that there are now a few systems which claim to have reached the practical and commercial stage, and are now putting their smaller scale development work to the severe test of daily production on a large scale. One such process, it is said, produces from a ton of average coal about 18 gallons of marketable oil, 4,000 cubic feet of gas, and 12 cwt. of residue.

These figures are significant. They imply that every ton of coal would have its potentialities fully exploited instead of some portion being wasted. The oil so produced could be used in ways that oil is already used; the gases could be used, as Mr. Hodges contended, by means of long-distance gas transmission, or, alternatively, near works for the production of electricity; and there still remains the residue which, ground to powder, possesses great efficiency as a fuel. It is with this residue that Captain Brand's paper is concerned, and dealing, as it does, with every detail of the manufacture and use of the pulverised fuel, it is a very interesting paper. It would seem that there is a reasonable hope of solving the problem, a problem of vast importance, of the most economical way of using raw coal.

THE METEOROLOGICAL DEPARTMENT OF INDIA.

I.

THE recent retirement of Mr. J. H. Field from his appointment of Director-General of Observatories is not an inappropriate time for taking stock of the present position of the Meteorological Department of the Government of India. That position will also be better understood if some reference is made to the previous history of the Department of which an excellent general survey was given in the Director-General's administration report for the year 1924-25. The survey in question was given in that particular year because the report of 1924-25 was the fiftieth administration report of the Department and therefore recorded the completion of the first half-century of systematic observations on weather in India. The Director-General, in that connexion, said that it would have been pleasant to have been able to call 1925 a Jubilee year, but as that would have implied not only a fifty years' course of work but a prosperous condition of the Department at its close, with adequate staff and resources, he considered it safer, in reviewing the progress made, to call the year the half-centenary. It is a little pathetic that such a remark should have been necessary; for there seems to be no reason why in a great country like India, where the work of the Department is sufficiently important to warrant all possible support and encouragement by the Government, there should not have been a Jubilee year, expressing a feeling of satisfaction, if not of rejoicing, at the results of half a century of labour.

From the earliest days of British interest in India there had been unsystematic observations regarding temperatures, rainfall and air pressure; sets of instruments were even issued, but without previous comparison with standards for determination of their errors and without any instructions for the guidance of observers; and little or no attempt was made to ascertain whether the data were of any scientific value. It was only at a few observatories of the first rank, established chiefly by the East India Company for scientific purposes, that observations of real value were recorded. In that way things went on till in 1857 Sir Richard Strachey, one of the ablest men of his day, called the attention of the Asiatic Society of Bengal to the uselessness of the desultory attempts that had up to that time been made to acquire a knowledge of Indian meteorology, and to the urgent need of a controlling authority. Sir Richard's action was not without avail, but then came the disturbance caused by the Mutiny, and it was not till 1864 that Mr. H. F. Blandford, formerly of the Geological Department, and at the time Professor of Science in the Presidency College, Calcutta, and one of the honorary secretaries of the Asiatic Society, drew up a report on the subject which was laid before Government. Almost simultaneously the Government were pressed to take action from another direction. In 1864 Calcutta was visited by one of the most destructive cyclones on record, a storm-wave rushed up the Hooghly, flooding the adjacent lowlands, causing 80,000 casualties in human

life, and wrecking a great part of the shipping in the river. A few weeks later a second cyclone led to the loss of the lives of about 40,000 persons. The attention of the mercantile and shipping community was then aroused, and the Bengal Chamber of Commerce brought to the notice of Government the inefficiency of a system under which no warning was given to ships of the approach of calamitous storms. In addition, about the same time, the Secretary of State for India urged the necessity of a systematic record of meteorological phenomena for the investigation of matters in connexion with disease, sanitary improvements and projects. These representations led to the establishment of meteorological offices in six of the provinces, and Blanford became the Meteorological Reporter of Bengal in 1867. Burma and the Native States remained, however, untouched, and nowhere was the work done with the thoroughness and success which attended the operations in Bengal. There had been no attempt to co-ordinate the separate systems, nor had there been any unity of aim and direction, and after prolonged correspondence between the Government of India and the Secretary of State it was finally decided to appoint an officer to consolidate the organisation for the whole of India. The appointment was very properly offered to Blandford, and in 1875 he assumed charge and laid the foundation of the present system of meteorological work in India.

Of the work of Mr. H. F. Blandford from 1875 to 1887, when owing to ill-health he took long leave and finally retired in 1889, it is impossible to speak except in terms of high praise. The first head of the Department, the rapid rise and development of its operations, were due to his sound judgment and zeal, and the high level of his scientific work was recognised beyond the confines of India. On his retirement he was succeeded, as Imperial Reporter, by John Eliot, another good bargain to Government. Mr.—afterwards Sir John—Eliot, an indefatigable worker of great ability, building on Blandford's foundations contributed in many valuable ways to the furtherance of the science of weather. He retired towards the close of 1903, and after his retirement saw through the press his last and most valuable publication, "The Climatological Atlas of India," described as "a unique storehouse of the climatology of a great unit of tropical land, a magnificent acquisition, a very mine of meteorological relationships, for which we cannot be too grateful to the enlightenment of the Indian Government and the patient labour of Sir John Eliot and his assistants." Eliot was succeeded on the 1st January 1904 by Gilbert Thomas Walker, Fellow and mathematical lecturer of Trinity College, Cambridge, and Senior Wrangler in the Tripos of 1889. Walker was a distinguished man when he came to India, and in India he made himself still more distinguished. He served for some twenty years, and with a longer tenure of office than his predecessors the Department in his hands made many noteworthy advances. It was said of him on his departure from India: "Scientifically speaking, his particular achievement has been to disclose factors, some of which occur half the way from India to the other side of the world, which influence the seasonal weather in India, to assess the true weight of each, and thus to reduce weather forecasting to a matter of mathematical calculation. It is the proved success of this method discovered and developed by Sir Gilbert Walker that gives the hope of its more perfect utilisation in future." Sir Gilbert did much to solve the problem of monsoon forecasting, and also in the more palpably useful work of warnings for floods inland and for storms at sea. To engineers warnings of floods for protection against danger and forecasts of breaks in the monsoon for purposes of construction programmes are of great value, Sir Gilbert was always anxious to help engineers, and the information he gave them on various occasions was of much worth.

The Government had been very fortunate in having in succession, as heads of the Meteorological Department, Mr. H. F. Blandford, F. R. S., Sir John Eliot, K. C. I. E., F. R. S., and Sir Gilbert Walker, C. S. I., F. R. S.; and they were again fortunate in being able to replace Sir Gilbert by Mr. J. H. Field, an officer of reputation, who had seen some twenty years' service in the Department. Mr. Field, when Sir Gilbert Walker retired, was at work at the Agra Observatory, an observatory of his own creation, and happy in his special research duties he made no claims to succeed to the post of Director-General of Observatories. Indeed, he disliked the change rather than otherwise, but his *nolo episcopari* was as ineffectual as in the case of Bishops and in 1924 he was called to the Simla headquarters.

(To be continued.)

IRAQ RAILWAYS.

THE report on the railways of Iraq by Brigadier-General F. D. Hammond gives the present position of these railways and makes certain definite recommendations for what is considered to be desirable in the interests of the country. Prior to the war, the only railway was a line from Baghdad to Samarrah on the standard 4 feet 8½-inch gauge, 74 miles long, which was constructed by Germany as a section of a much larger Baghdad Railway scheme. This section, which had been completed when the war broke out was extended for military purposes by the British, during the war, from Samarrah to Sharqat, the present northern terminus. Mosul, which it is desired to reach, is 70 miles distant from Sharqat, and between these two places the country is a desert. The existing railways are then the line from Baghdad to Sharqat, 186 miles of standard gauge, and 624 miles of metre gauge between the Port of Basra and Baghdad and Kirkuk. General Hammond's proposals are to extend the metre gauge line from Kirkuk to Mosul as preferable to the Sharqat-Mosul route because it would pass through a cultivable area instead of desert and would not be more than 30 miles longer. The existing line between Samarrah and Sharqat would be dismantled and the rails used for the new extension. The Baghdad-Samarrah line would be converted to metre gauge, and the whole system would then be a metre-gauge one. General Hammond also recommends that the Tigris river at Baghdad should be bridged to supersede the present Waggon Ferry which is unsatisfactory. The total cost of the scheme is estimated at Rs. 1,47,90,000.

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Notes and Comments.

America's Concrete Roads.—During 1927 areas of concrete road were laid in America equivalent to an 18-feet road, 10,900 miles in length. There are approximately 80,870 miles of this type of road now carrying traffic in the United States.

Dutch Air Service.—The Royal Dutch Air Lines are completing arrangements for the world's longest air mail service, from Amsterdam to the Dutch Indies. The service, which will consist of one aeroplane in each direction once a month, will not carry passengers.

Armstrong Whitworth.—We are informed that the Board of Sir W. G. Armstrong Whitworth and Co., Ltd., have appointed Lieutenant-Colonel W. T. C. Huffam, O. B. E., M. C., their chief representative and local director in India, Burma and Ceylon with offices in Bombay.

French Airmen's Flight.—The French airmen, Captain Costes and Lieutenant Le Brix, were accorded a magnificent reception on their arrival in NewYork from Washington where they lunched with President Coolidge. They have flown 22,000 miles since leaving Paris with the purpose of attempting a New York-Paris flight.

Telephonic Communication.—The new service was officially inaugurated on the 11th instant between Germany and the United States, which is an extension of the Anglo-American wireless telephone service. The conversations are transmitted over land-lines to London, then by wireless from Rugby station to the American receiving station, and from there by land-lines again to their destination.

The Increased Use of Concrete.—The increased popularity of concrete for all types of structural work is evidenced by the production figures for Portland cement over the past few years. In 1907 the use of Portland cement *per capita* in England was 111 lb., in 1924 it reached 123·9 lb. and the figure has increased annually until 1927 shows a return of 177·9 lb. The actual production of British cement in 1927 was 4,120,000 tons. Not only was there a bigger demand in the home market but there was also an appreciably increased demand in the export markets.

A New Motor Tug for the Cochin Harbour Board.—A noteworthy feat has recently been achieved by the completion in ten weeks of a fine new motor tug which has just been put into service by the Harbour Department of Cochin. She is 40 feet long by 9 feet beam and 2 feet 10 inches draft, and is equipped with the very latest type of motor machinery which has been supplied by the Ailsa Craig Motor Co., Ltd., of Chiswick, London. This machinery consists of a 6-cylinder 28-36 h.-p. marine motor engine fitted with electric starting motor and a dynamo for lighting the ship. With this powerful engine and a good turn of speed she is one of the finest boats in Cochin.

Hillman in Tanganyika.—A Hillman owner in Tanganyika Territory reports, in a letter to Rootes, Ltd., that he has found this "the finest car one could possibly procure for a hot country." He recently covered the journey from Kilosa to Newala, and back, a distance of 2,500 miles, this being the first time that this trip has ever been done by car. Up the Mahenge Hill—an approximately 8-mile pull—the Hillman took her full load without overheating, whereas it is stated that up to date all other cars, great or small, which have attempted this climb have been guilty of boiling. He adds that he is getting twenty-two miles to the gallon of petrol, and that the only accident he has suffered from is a succession of 17 punctures in one day. This was due to the fact that a herd of elephants pulled down a number of trees across the road, whereby many sharp-pointed thorns were left in the sand.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 2nd February :—Messrs. Martin and Co., Calcutta—Spares, for Ruston 135 Dragline Excavator, Rs. 2,889 c. i. f. Karachi; Spares, for Ruston 300 Dragline Excavator, Rs. 2,999 c. i. f. Karachi; 130 cwts. Round, M. S., ½ inch diameter, Tata, Rs. 1,057 f. o. r. Calcutta; Messrs. William Jacks and Co., Bombay—104 Windows, Crittal, metal, complete, 3 feet ½ inch by 3 feet 3¼ inches, type Cz7, Rs. 2,633 free delivery Jhansi; 104 Windows, Standard, Clerestory, complete, 2 feet by 3 feet 6 inches, Rs. 1,680 free delivery Jhansi.

The Restoration of St. Mark's Cathedral, Venice.—St. Mark's, Venice, one of the three great national cathedrals which have been in the hands of workmen to ensure their safety, is now pronounced secure. The English St. Paul's, the German Mayence Cathedral and the Italian St. Mark's, undoubtedly owe their restoration to the world's most versatile building material—Portland cement. St. Mark's, originally built in 1063, was decorated and faced with marble by the Venetians after the Fall of Constantinople but the substructure was left distinctly weak. For twenty years the work of filling in cracks in the vault has been in progress and the damaged stones and mortar have been replaced with concrete.

Bedi Bunder Port.—Rumour is busy regarding the future control of the port of Bedi Bunder (Kathiawar), the rapid development of which provoked intense agitation in Bombay, culminating in the re-imposition of the Viramgan Customs Cordon. It would appear that the present settlement is not to be the last word on the question, and that the Government of India wish to step further in an attempt to remove all causes of complaint coming from whatever quarter. This, it is reported, they intend to do by getting possession of the port, and with this object, they are understood to have made an offer of 60 lakhs. Though the Jam Saheb of Jamnagar is said to expect considerably more, an agreement is regarded as almost an immediate probability. A settlement of this point will be followed by the removal of the Customs line which has been reported to be the cause of considerable hardship to traffic, goods as well as passenger.

New African Railway.—Mr. T. A. Barnes, an explorer, just returned to England from a trip across Central Africa, including the whole length of the new 770-mile railway from Lobito Bay to Luacono on the Anglo-Belgian Congo frontier, which is now nearing completion, said that the railway would revolutionise travel to the Sub-Continent and open up lost territory, namely, Portuguese-Angola, which many considered the richest agricultural country in Africa. The railway also would save about 2,500 miles, enabling Central Africa to be reached directly from Lobito instead of *viâ* Suez and Dar-es-Salaam, or *viâ* the Cape. The entire scheme of a direct rail route between Lobito and Dar-es-Salaam, joining the Cape to Cairo route at Elisabethville would take some time to realize, but the outlet to the west coast was most important commercially. Anglo-Congo would provide enormous fields for British manufactures of cotton goods and agricultural machinery.

Back Bay Disclosures.—It is reported that it is unlikely Mr. Nariman will proceed to England for the purpose of instituting a libel case against Sir Lawless Hepper there. He does not, however, intend to let the case rest and is asking his solicitors in England to ascertain whether service of a summons will be accepted in a libel suit in this country. Many members of the Corporation Council are striving to stir up public opinion, in view of the disclosures in the Nariman suit and there is little doubt that a vote of censure will be moved in the Council against Government mismanagement. Opinion is general in both official and private circles that the gravest mal-administration has prevailed throughout the whole scheme from inception to finish. Meanwhile, with more or less the same material and resources as have always been available, the scheme is proceeding quickly towards completion, without such hitches and handicaps as prevailed formerly. The dredgers "Kalu" and "Jinga" are now working usefully. These facts will be made use of when the vote of censure is moved.

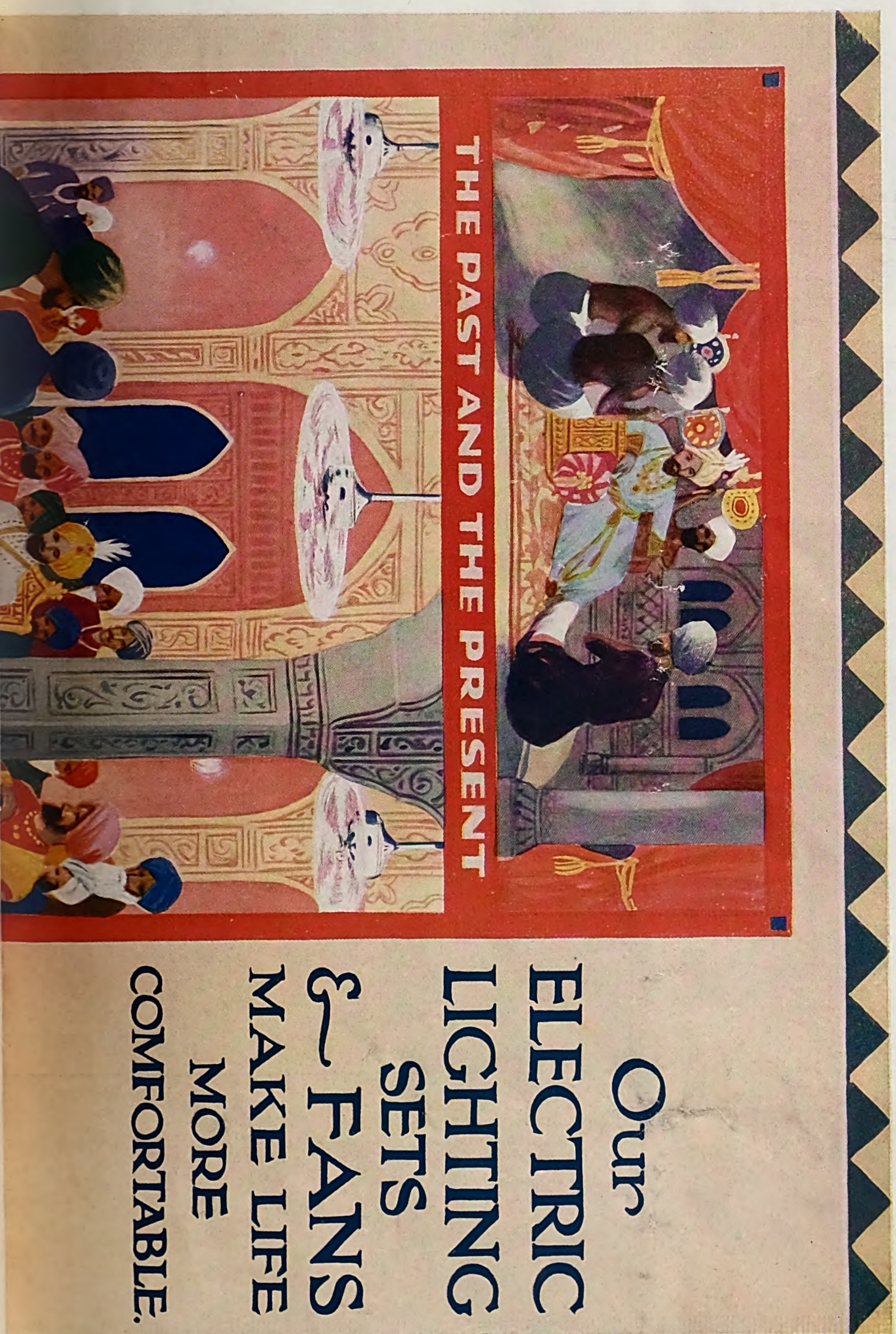
Lahore Waterworks Scheme.—A new waterworks scheme for Lahore has been proposed by the Government Sanitary Executive Engineer, Mr. Howell. He explained to the Municipal Committee at a meeting recently that the existing water supply was installed at a cost of Rs. 15 lakhs in 1884 and had done good work, but was now absolutely inadequate. For the new supply two alternative schemes have been considered: tube wells or direct Ravi supply. Government engineers did not favour tube wells, as their life was only 10 years or less in Lahore. The other scheme was for pumping direct to Lahore from the headworks on the Ravi near the railway bridge. The site was safe from floods. The old reservoir would be retained for the city only and a new reservoir constructed outside the Bhati Gate to supply the civil station through three mains. The design is for 30 gallons per head of the present population, but capable of expansion for increase of population after completion in 1931. The supply is to be continuous for 24 hours and the pressure will ensure the highest levels being commanded. It had been suggested by Government to obtain power from the Mandi hydro-electric station when available.

World's Largest Drum-Shaft.—What is said to be the largest drum-shaft ever manufactured was recently made in the steelworks of William Beardmore and Co., Ltd., Glasgow. It is for an electrically-driven winding engine in the City Deep Mine, South Africa. The shaft will carry two gigantic drums, each 35 feet in diameter and 350 tons in weight. Each of the winding cables is 2¼ inches in diameter and weighs 18 tons. The shaft is driven direct by motors 20 feet in diameter, capable of dealing with a peak load of 9,240 h.-p., and weighing 300 tons. This winding apparatus is designed to raise 9¼ tons of ore from a depth of 4,500 feet at the rate of 31 "journeys" per hour, the winding speed being some 60 feet per second. The manufacture of this shaft obviously required great care during the different stages. It is in three pieces, coupled together, and measures 84 feet 6 inches overall; external diameter, 22 to 42 inches; internal diameter, 8 to 18 inches and it weighed when complete 92 tons. It required for its manufacture an ingot weighing 120 tons. When the three shafts were coupled together—with bolts which measured 6½ inches in diameter—the complete shaft was put into one of the largest lathes in the shop, finally machined, and carefully tested for alignment to make certain that all the journals were truly in line.

Pensioning off Old Machinery.—Worn out machinery is usually thrown aside on to the scrap heap without ceremony, but cases occur sometimes in which the owners have such an affection for old engines and consider that they have given them such good service that they deserve a better fate. A case of this kind occurred recently in Peru on the Cayalti Estate of Messrs. Aspillaga. An old set of cable ploughing engines built by Mess rs. John Fowler and Co. (Leeds) Ltd., which have given 43 years' of useful service were to be put aside as the work could all be covered by larger and more recent models. As the owners expressed it they "still had a kick in them;" but they were not worth extensive repairs. They considered, however, that the development of the estate in the last 40 years was so closely connected with the use of these engines that they would like to put up a lasting memorial to their performance. It was decided therefore, to "pension them off" by allotting to them a permanent position at the entrance gates of the factory, and in order that every honour should be done to these old servants of the company the engines were completely decorated with flowers and flags, the factory band was turnd out, and the whole staff collected so that Mr. Aspillaga could explain to them the importance of the occasion and the value of the services rendered by the engines which had made them worthy of such an honoured position.

British Six and Eight-Wheeled Vehicles.—Among the full range of their products exhibited by Scammell Lorries, Ltd., at the recent very successful Commercial Vehicle Show held in London were a standard 12-ton Contractor's Lorry and a 2,500-gallon frameless Milk Tanker having a glass-lined tank. Both these machines represent types which the firm has been building for a considerable period and of which there are large numbers on the road. In addition, however, two entirely new machines of great interest were shown. The first was the new eight-wheeler lorry for loads of 15 to 17 tons. This is quite a new model, but several have already been delivered and a considerable number are now on order. This machine marks a great step forward in road transport efficiency, among its outstanding features, in addition to its large load-carrying capacity, being the fact that the tyres are not overloaded and that the rolling resistance is amazingly low. In a 50 miles run over second-class roads, for instance, as much as 132 ton-miles per gallon have been obtained—a record for any type of road vehicle. The other new machine exhibited was the Scammell rigid six-wheeler, designed specially for Overseas use and to stand up to the most arduous conditions. Its cross-country capabilities are certainly phenomenal; it is significant that a number of this type are on order for the India Office, the War Office, Shell-Mex, Ltd., and Venezuelan Oil Concessions, among others.

Automatic and Electric Furnaces, Ltd.—We have been informed that an agreement has been entered into between this firm in London and the Allgemeine Elektricitats Gesellschaft, Berlin, whereby this latter company will now manufacture and sell Wild-Barfield electric furnaces in Germany, Austria-Hungary, Jugo-Slavia, Bulgaria, Turkey, Greece, Roumania, China, Finland and Luxemburg. This agreement will not in any way affect the firm's existing manufacturing and selling arrangements which are in Great Britain, Australia, New Zealand, S. Africa, Spain, Scandinavia, Japan and Russia. La Compagnie Francaise Wild-



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THE PAST AND THE PRESENT
ELECTRIC FANS
Our ELECTRIC LIGHTING SETS & FANS MAKE LIFE MORE COMFORTABLE.
SIEMENS (INDIA) LTD.
CALCUTTA
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BOMBAY
P.O.BOX, 898.
LAHORE
P.O.BOX, 147.
RANGOON
P.O.BOX, 64.
H.T.

The chief advantages

of

SIEMENS SCHUCKERT'S
HOUSE LIGHTING SETS

ARE :

1. Greatest reliability
2. Simple attendance
3. Highest economy
4. Smallest erecting space
5. Low fuel consumption
6. Easy erection
7. No water cooling

SIEMENS

HOUSE LIGHTING SETS give the possibility of a safe electrical installation for lighting and power in Country Houses, Hotels, Estates, Theatres, etc., and there is no special knowledge required for :: their erection and attendance ::

The Times Press, Bombay.

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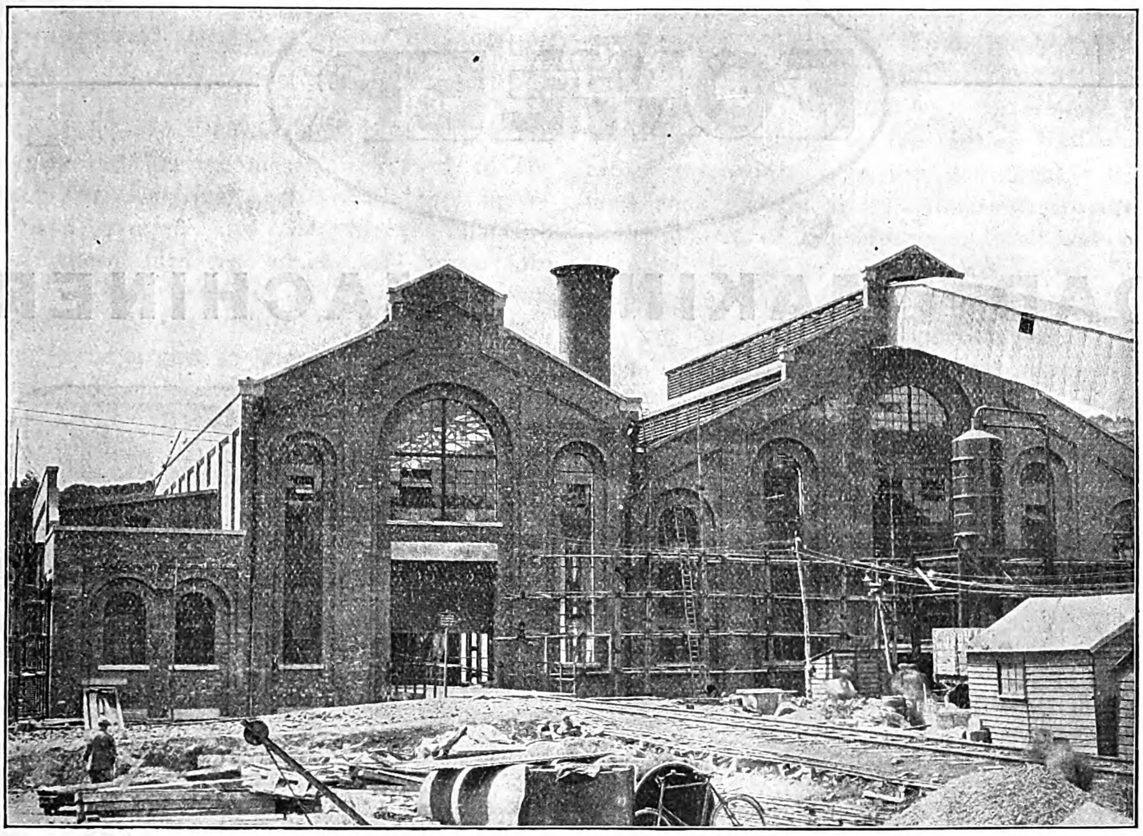
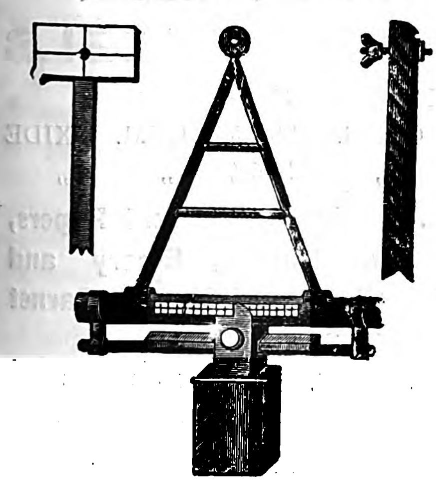
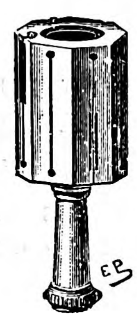
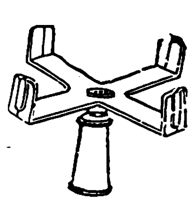
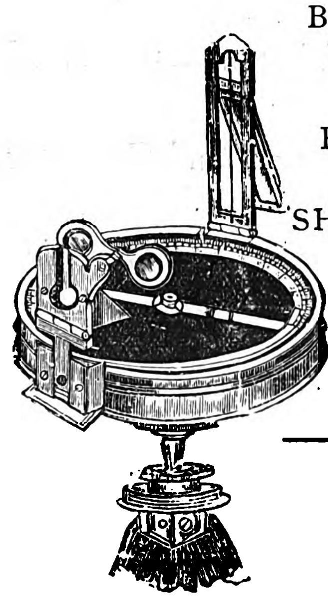










Barfield, 3, Villa St. Mande, Paris, France, manufacture and sell Wild-Barfield electro-magnetic furnaces in France, her colonies, Belgium, Switzerland, Holland and Poland. Carlo Brivio, *vià* Principe, Umberto, 25, Milano, 112, Italy, also manufacture and sell these furnaces in Italy and her colonies. In regard to the United States of America and Canada, an agreement has been entered into for the manufacture and sale of these furnaces which will come into actual operation early this year. The firm's own factory, Elecfurn Works, North Road, Holloway, London, N. 7, is the largest in Europe, solely devoted to the manufacture of electric furnaces and the firm's new shop for demonstrating their use to prospective users is the most modern in the United Kingdom. The company have received recent orders from a large number of well-known firms.

The Progressive Sudan.—Justice is being meted out to the Nuer tribe in the Sudan, says the "Civil and Military Gazette," for the murder of Captain Fergusson and his companions. The revolt, such as it was, appears to be a strictly localised movement which does not affect the tranquility of the Sudan as a whole. The last report on the administration of that country bears convincing testimony to the progress achieved in turning chaos into order and to the solid benefits of the present regime to the people of the country. The report admits the fair deduction that when the Sudan was described by malcontents at Cairo as in a state of incipient revolt, this was an artificial and malicious invention almost on a level with the simultaneous unrest in Egypt itself. The conclusion is that so long as the Sudan is preserved from outside interference, it will remain one of the best bulwarks of Egyptian security and civilisation. The year 1926, it seems, was preceded by a couple of years of drought, and grain-crops had sunk to a minimum. But with the opening of the Sennar dam a couple of years ago, 50,000 acres under irrigation were planted with grain, and importations from India helped to overtake arrears of production and fill up reserves. The new dam also caused a new area to be devoted to cotton, and a million pounds Egyptian was the harvest result for the cultivators of this crop alone. With the extension of irrigation schemes, the year 1930 will see £11,500,000 of capital invested in this particular cotton industry, with a corresponding advantage to the growers. Other activities—those of missionaries, schools, and the training of nurses especially—are going steadily ahead, and the Sudanese are encouraged to take their share in administrative matters. Roads and railways are extending, and the pilgrim movement of Moslems to Mecca is being promoted and helped year by year. Could there be a better answer to the diatribes and calumnies of Cairo?

Punjab Land Sales.—The Punjab is disposing of a good large quantity of Crown lands in the Lower Bari Doab and Nili Bar during the next month by auction sales:—(*i*) 28th and 29th February. Town sides at Vihari on the Qasur-Lodhran Railway lines in the Nili Bar. (*ii*) 6th, 7th and 8th March. Crown land in Nili Colony, aggregating 10,000 acres in chaks: 39/E. B. on 1L Distributary near Arafwala. 209, 219, 221, 223/E. B. on 3L Distributary near Fitna. 471 and 473/E. B. on 5L Distributary near Burewala. (*iii*) 12th and 13th March. Crown land in the Lower Bari Doab Colony in the Khanewal tahsil of Multan District, aggregating 23,816 acres to be auctioned at Khanewal. These sales are advertised in "The Civil and Military Gazette." The total area which it used to be believed possible for the land market to observe each year without causing a slump, was 40,000 acres. This total was to be made up between the three partners in the Sutlej Valley project, in areas proportionate to the estimated area of State land each partner is to ultimately provide. Bikaner was left out of consideration, as it was said its contributions would be comparatively small. The 40,000 acres were to be divided between Bahawalpur State and the Punjab in the proportion of 2 to 1, or, say, 14,000 acres Punjab and 26,000 acres Bahawalpur. The total of Punjab land advertised for sale during the next month is 34,000 acres. If this constitutes the total the Punjab will put on the market during the whole year, then Bahawalpur State should sell 68,000 acres, making 100,000 acres to be sold in a single month. It would seem that, either the capacity of the land market has expanded beyond all bounds, or the competition of Bahawalpur State has been successfully manœuvred into the background and the Punjab thus acquired a monopoly of the market, or the land is being sold very much cheaper than it was expected. What has happened?

Indian States Committee.—Following the example of the Maharaja of Jodhpur, the Ruler of Bikaner welcomes the appointment of the Butler Committee in the course of his speech in the State Legislative Assembly on the 20th January: "I feel sure that I am voicing the sentiments of the Princes and States generally when I say this—that it is a matter of congratulation and of gratification and in the Imperial interests as well as in the interests of the States, that such an important investigation is to be carried out in Lord Irwin's Viceroyalty, with at his side, as his Political Secretary and chief expert adviser, a sympathetic officer like Mr. C. C. Watson; while the whole of Indian India will be highly gratified at the appointment as Chairman of the Committee of such an eminent statesman and sagacious administrator as my old and valued friend, Sir Harcourt Butler. Sir Harcourt has inspired general respect and confidence and made a great name for himself, both as one of the greatest Governors of modern times of more than one British Province, and as by universal consent, the most popular and sympathetic Foreign Secretary, at least in our time, when he proved himself to be such a genuine and true friend of the Princes and States, and gained their undying friendship and gratitude by being instrumental in bringing about a generous and liberal policy of greater sympathy and trust for the Indian States, and thereby rendered the States considerably happier than he found them." He describes as futile the demands in certain quarters that their ancient treaties and alliances should be scrapped or revised under various grounds, including the argument that these are obsolete and that the Princes have no sovereign rights. "The subject of interference and intervention in the internal affairs of States is too important and comprehensive to deal with adequately in the course of a few sentences, even if this was the right time and place to do so. Suffice it to say that the sooner such notions are dismissed from the minds of all concerned, including the refrain—'The States must go'—the better it would be for the destiny of our Motherland. For the Indian States have no intention to meekly submit to any such demands; and they certainly will not go under without a struggle."

Current News.

A RADIO station, with a capacity of 5 kilowatts, is to be installed at Winnipeg, Manitoba.

MR. E. L. GLASS, Superintending Engineer, Central Provinces, has been transferred to Bihar and Orissa.

THE cost to date of the Welland Ship Canal has been about 90,000,000 dollars, and it is 78 per cent. complete.

A NEW pier for ocean-going vessels is to be built on the North Shore of Vancouver Harbour at a cost of 150,000 dollars.

MR. E. FRASER is appointed to officiate as Chief Engineer, G. I. P. Railway, *vice* Mr. R. V. Symons, granted combined leave for two years.

A LOW-TEMPERATURE coal carbonisation plant is to be put up at Askern, near Doncaster. It is to have a capacity of 3,000 tons of coal a week.

DR. L. L. FERMOR is appointed to officiate as Director, Geological Survey of India, *vice* Sir E. H. Pascoe, granted 8 months' leave.

ACCORDING to Mr. Harold Moore, petrol which has escaped from a tanker and has floated a distance of from 10 to 13 miles, has become quite safe.

AN electric power plant, which is to cost about £1,000,000, and will serve an area of 10,000 square miles, is to be constructed at Estevan, Saskatchewan.

SIR RONALD ROSS, the well-known malaria expert, has greatly benefited by his convalescence in Gibraltar, and is now back at his Institute in London.

DR. HAROLD MANN, formerly Director of Agriculture, Bombay, left Marseilles on 17th February for India as Agricultural Adviser to the Government of the Nizam of Hyderabad.

A NUMBER of telephone subscribers in Shanghai who are on the central exchange on the manual system will be transferred to a new automatic exchange of the latest design early this year.

THE Government of Mysore has in view schemes for the generation of electric power on a large scale at the Gersoppa Falls and at the Mekadatu Falls of the Cauvery River below the Sivasamudram Falls.

ARRANGEMENTS are being made by the Victorian State Rivers and Water Supply Commission to begin the construction of the Eppalock reservoir on the Campaspe River, an important tributary of the Murray River.

THE Government of India have sanctioned the construction by the Jodhpur Durbar of a branch line, on the metre gauge, from Sandari, a station on the Jodhpur State Railway, to Bhinmal, a distance of 75 miles.

THE gross tonnage of vessels handled at Southampton during last year amounted to some 15,200,000 tons, inward, as compared with 14,600,000 tons for the previous twelve months. The outward tonnages were slightly less in both cases.

RECEIVERS have been appointed for the Central Vermont Railway at the instance of the Canadian National Railways which own the bulk of the capital. Funds are required for repairs necessitated by recent New England floods.

SIR ASHLEY BIGGS, Agent, Madras and Southern Mahratta Railway, left Madras on the 9th February for Bombay *en route* to England on six months' leave preparatory to retirement. Mr. F. B. Wathen, General Traffic Manager, succeeds him as Agent.

EXPERIMENTS are being carried out by the Imperial Institute off the end of Southend Pier to determine the relative merits of Manilla and East African sisal for ropemaking. It is reported that the sisal has already proved superior, but the experiments are being continued.

WHAT is claimed to be one of the largest gold dredgers has been put to work on the river Lena, Siberia. It is electrically driven and is capable of dredging to a depth of 80 feet, while the tailings are discharged at a radius of 176 feet. The motors on board have a combined output of 1,335 horse-power.

THE River Weir Commissioners have decided to spend £18,580 on electrical equipment at the Hendon and Hudson Docks, and from £1,500 to £3,000 in removing the invert at the Hendon Dock junction gateway. They have also decided to lengthen the Hendon Dock foreshore breakwater at an estimated cost of £5,000.

THE Railway Board have sanctioned a Traffic Survey being carried out by the agency of the East Indian Railway Administration for a line of railway on the 5 feet 6-inch gauge from Shahjahanpur to Mailani, a distance of about 40 miles. The survey will be known as the Shahjahanpur-Mailani Railway Survey.

A DISCOVERY, which may save an enormous amount of money, has, according to the "Daily Telegraph," been made by a Danish manufacturer. It is described as a wood-oil for killing dry-rot, and the experiments which have been made are said to have proved successful. The "wood-oil," the compsoition of which is the inventor's secret, renders wood fireproof.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

NEW YORK EDISON COMPANY.

SIR,—An electric generator rated at 160,000 kilowatts is to be installed by this Company in its generating station at 14th Street and East River. The generator will have a capacity nearly three times as large as any in service, and more than half again as large as any under construction anywhere in the world. The generator will be driven by a tandem-compound steam turbine, which means that all the equipment will be mounted on a continuous shaft. Included will be a single-flow high-pressure turbine element, a double-flow low-pressure turbine element, the electric generator, and a direct-connected exciter. The tandem-compound turbine differs from the cross-compound turbine in which the different turbine elements drive separate electric generators. The new generator will be rated 160,000 kilowatts at 1·00 power factor, 1,500 r. p. m., 3 phase, 25 cycles and 11,400 volts. The turbine will receive steam at a pressure of 400 pounds and a temperature of 700 degrees Fahrenheit, and will exhaust at one inch absolute pressure. The entire set will be 82 feet 7 inches long, and will weigh 2,228,000 pounds—well over a thousand tons. Installation of the equipment will be completed by 1st October 1928.

R. C.

FLOOD DISCHARGES.

SIR,—For what they may be worth I submit the factorized data upon the table (Mr. Granville's article II) printed at the top of page 363 of your issue dated the 24th December 1927. The equation used is $v=C\sqrt{m}$. To find d, the quantity 55·00 has been deducted from the heights of floods above datum, whence f is calculated. The v assumed are as *calculated*, not observed (a matter of great difficulty).

Cal. v	d	y	m	f	C
13·84	48·84	16·28	39·55	2·429	0·454
12·25	40·00	13·33	31·09	2·332	0·455
8·30	18·00	6·00	14·40	2·400	0·457

Hydraulic engineers will be interested in the f results and in the approximately constant C. What empiric formula was used to determine v by calculation ?

Σ. Φ.

17th January 1928.

Literary Notices.

Bihar Engineering College Magazine.—The issue of this publication, Vol. II., Nos. 1 and 2, April and November 1927, is one which is full of instructive matter and should prove attractive to all the members of the profession in the province. Mr. S. C. Ghosh, B. Sc. (Glas.), A. M. I. C. E., the Editor, in an editorial complains of the lack of support the magazine receives from those who should support it. The College also suffers from the neglect shown towards it by the authorities. This is undoubtedly a very great pity, for it is a college which both the Government and the cadre of engineers in Bihar and Orissa should strongly support. Not only financial aid by the Government and the public is required but also technical papers by those engaged in practical work. The issue just published contains some excellent articles. The first (accompanied by a good reproduction from a photograph) gives a short account of the excellent work done by Mr. F. Walford, O. B. E., A. R. C. S., M. I. M. E., late principal of the college (retired). This is followed by an article on "Improved Bonding in Brickwork" (illustrated) by Mr. A. K. Dutta, B. E., C. E., A. M. I. E., Consulting Engineer, Lucknow. Next a most interesting account (accompanied with a fine reproduction from a photograph) of the life and work of that prince amongst men and one of the most distinguished of engineers Sir Ganga Ram, a truly noble son of India, a fine example for all the sons of the motherland to follow. "The Design of Reinforced Brickwork Slabs" by Jwala Prasad, Lecturer in Civil Engineering, is a most informative one, and will prove of service to engineers. An article entitled "Doon" furnishes valuable information regarding Dehra Dun. A pleasing account of the work done by Professor B. C. Das (with photograph) whilst Professor of Mathematics in the College, who has retired but is still remembered, concludes the articles. A large number of useful engineering notes and other matter are appended.

Gaekwar's Baroda State Railways.

TENDERS FOR STEEL WAGONS.

TENDERS are invited for the following wagons (2'-6" gauge) complete :—

50 Steel Covered goods bogie wagons.
50 Steel Open high-sided bogie wagons.
50 Covered goods four-wheeled wagons.

Separate sets of drawings and specification for the above wagons can be obtained from the Manager and Engineer-in-Chief, Gaekwar's Baroda State Railways.

The tenderers should quote their rates "C. I. F. Okha Port" and mention the time of delivery in their tenders.

Tenders, addressed to the Manager and Engineer-in-Chief, Gaekwar's Baroda State Railways, Goyagate (Baroda) marked **"Tender for Covered Wagons"** or **"Open Wagons"** as the case may be, should reach the undersigned not later than the 15th March 1928.

The undersigned does not bind himself to accept the lowest or any tender.

C. A. COOKE, O.B.E.,
MANAGER AND ENGINEER-IN-CHIEF,
Gaekwar's Baroda State Railways.

Manager and Engineer-in-Chief's Office,
Dated GOYAGATE (BARODA),
The *4th February 1928.*

RAILWAY BOARD.

NOTICE.

Broad and Metre Gauge Underframes and Goods Stock for Indian Railways.

TENDERS are invited for the construction in India of broad and metre gauge underframes and goods stock, complete with all fittings and *wheels and axles*, except as otherwise specified, for delivery between April 1928 and March 1929.

2. Applications for copies of the Form of Tender, Conditions of Contract, Schedule of materials and parts to be imported, Drawings and Specifications should be made to the Agent, Eastern Bengal Railway, Koila Ghat Street, Calcutta, at whose office the Drawings will be on exhibition. Drawings will be supplied at Rs. **1-8-0** per sheet, payable to the Agent, Eastern Bengal Railway. These fees will not be refunded. Information regarding details other than those given in the tender documents should be obtained direct from the Agents of the Railway Administrations for whom the underframes or stock is required.

3. The following underframes and vehicles are required:—

Broad Gauge.

Description.	Number required.
68′ I. R. S. Underframes	281
27′ 6″ I. R. S. Underframes	252
19′ 6″ Underframes	218
Petrol tank wagons	48
Oil tank wagons	15
Bogie rail and Timber trucks	47
Bogie Open Wagons	53

Metre Gauge.

Description.	Number required.
56′ 6″ Bogie Coaching Underframes ..	152
24′ 0″ six wheeled carriage underframes ..	6
20′ 0″ four wheeled underframes	33
18′ 0″ four wheeled underframes	5
Bogie Coaching Underframes to Burma Railways design	50
20′ 0″ four wheeled goods brake vans M. E. 1 type	29
M. A. 2 type covered goods wagons ..	550
M. C. 2 type open wagons	60
Ballast wagons on M. C. 2 type underframes ..	110
M. A. 1 type covered goods wagons ..	300
M. C. 1 type open wagons	22
M. B. R. type rail and timber trucks ..	3
M. B. K. 1 type petrol tank wagons ..	5

4. Schedule I (Annexure A) should be submitted typed in triplicate.

5. Tenders must be enclosed in sealed covers and superscribed "Tender for broad and metre gauge Underframes and Goods Stock" and should reach the Secretary, Railway Board, Delhi, before 11 A.M. on Tuesday, 13th March 1928, at which hour and date they will be opened and the quotations announced by the Secretary, Railway Board, or an officer acting on his behalf, for the information of any tenderers who may desire to be present.

6. For broad gauge stock, tenders must include the cost of completely erected underframes or goods vehicles, delivered on their wheels f. o. r. at the manufacturers' works. For metre gauge stock, tenders will include the cost of rivetted up underframes together with the wheels and axles, axle guards, and all details securely packed or bundled f. o. r. at the manufacturers' works except as otherwise specified in the tender documents. The wheels and axles will be supplied by and at the cost of the manufacturers, except as otherwise specified.

7. The date subsequent to the 1st April 1928, on which delivery will commence and the period within which the order will be completed, as well as the number of wagons and underframes that will be delivered per week must be stated, for each item separately, in the Schedule of Requirements (Annexure A) attached to tender form.

8. Offers of a lump sum reduction for large orders will be considered if submitted at the time of tendering.

9. Tenders for less than the full number of underframes or goods stock of any one type may be submitted.

10. The tender prices will be for the designs as made, but should alterations in the design be found necessary at the time of placing the order, or during the execution of the work, the consequent variation in the tender prices will be settled by negotiation.

11. The quality of material and standard of workmanship must satisfy the specifications in every respect.

12. The Railway Board reserve the right to reject any tender without assigning a reason; and do not bind themselves to accept the lowest tender, the whole of a tender or any tender.

13. Tenderers must satisfy Government that:—

(i) a substantial part of the manufacture will be done in India;

(ii) in making purchases of materials for the construction of wagons and underframes Indian manufacturers will be given an opportunity to tender.

14. Firms that are not on the approved list for supply of wagons and underframes should, when submitting tenders, support the tender with a certificate from the Indian Stores Department to the effect that they possess workshops and appliances for turning out work of the desired standard and within the period quoted in the tender.

15. No covering letters to tenders should be sent.

16. After tenders have been submitted, no representatives of the tendering firms will be granted interviews for the discussion of matters connected with tenders.

J. KAUL,
Secretary, Railway Board.

Foreign Notes.

Electrification of Italian Railways.—In October 1922 the length of railway lines run by electric traction in Italy was 689 km. (420 miles). From that date to June 1927 a further 370 km. (226 miles) were added. Since then the electrification of the Bologna-Florence and of the Naples-Villa Literno lines has been completed. By the end of 1927 the Foggia-Benevento and the Rome-Avezzano lines were to add a further 325 km. (198 miles) to the total. In 1929 the Bolzano-Brenner and the Ovada-Alessandria lines, covering a distance of 268 km. (163 miles), are to be electrified, followed in 1930 by a further 444 km. (271 miles), represented by the Cuneo-Ventimiglia, the Savona-Ventimiglia, the Parma-Spezia and the Benevento-Naples lines. So that by the end of that year over 2,000 km. (1,220 miles) of railway line will be run by electric power in Italy. The Modane-Leghorn line (457 km. = 279 miles), now entirely electrified, is the longest line so run in Europe.

Wireless Stations in Manchuria.—Eleven wireless stations are operating in North and South Manchuria, including Mukden, Newchwang, Changchun, Harbin, Kirin City, Tsitsihar, Manchuli, Yenchi, Suifengho, Fuching, and Heiho. The stations are able to communicate with Europe. A pact for communicating with Germany was recently signed, and another with France is being negotiated. The total cost of constructing the stations is estimated at 1,300,000 dollars, besides another 400,000 dollars for training students. A wireless telegraphy school in Mukden has over ninety students, divided into engineering and intelligence departments. The entrance requirement is senior middle school graduation. The course for engineering is four years, and for intelligence two years. The Japanese have also established wireless stations at Dairen, Liushutum, and Shahokow, and exchange messages with the Chinese stations in Manchuria. A broadcasting station was recently organised in Mukden by both officials and merchants.

Welding of Steel.—According to Captain H. C. Richardson, U. S. N., the welding of steel, in aeroplane construction, particularly chrome molybdenum steel, is very generally accepted as satisfactory practice in America, with the limitation, however, that welds in tension are not considered reliable. To avoid this, it is usual practice to introduce gussets at joints or long scarfs in which adequate welding is presented in shear; and where the loads are high it is usual to slot the gussets through the members to gain additional shearing values. In such cases it is also usual to incorporate in these gussets the attachment lugs for connecting other members. Electric and gas welding are acceptable, but acetylene welding is considered hazardous. In all welding, since it is impracticable to determine the interior condition of a weld by inspection, it is considered essential to have this work done by skilled and reliable workmen. Local reinforcements are often accomplished by brazing. If brazing is to be associated with welding, it should be done subsequent to the welding.

International Railway Congress.—The subjects to be discussed at the International Railway Congress in Madrid in 1930 have now been announced. They are :—(1) The use of concrete and reinforced concrete on railways; (2) resistance of rails against breakage and to wear; (3) investigation into static and dynamic stresses in railway bridges; (4) recent improvements in permanent way tests and in the scientific organisation of maintenance work; (5) locomotives of new types, in particular, turbine locomotives and internal-combustion motor locomotives; (6) improvements in the steam locomotive; (7) electric locomotives for main line traction; (8) all steel coaches—comparison with vehicles built of wood; (9) relations between railways and seaports; (10) methods to be used in marshalling yards to control the speed of vehicles being shunted; (11) signalling; (12) economical traction methods for use in particular cases; (13) competition of road transport; (14) use in railway work of machines for accountancy; (15) co-operation of the staff; (16) training of the staff; (17) and (18) light railways; (19) electrification of secondary lines; (20) rail motor vehicles.

Manganese Ore in South Africa.—It is officially announced that the New Consolidated Gold Fields, Limited, and their associates have decided to abandon their working option over the manganese properties of the Union Manganese Mines and Minerals (S. A.), Limited, in the Postmasburg district. The reasons assigned by the Gold Fields Company are the difficulty of obtaining a footing in the European markets for the sale of manganese ore, and the difficulties encountered in connection with the construction and financing of a railway line to the properties. The directors of the Union Manganese Mines and Minerals (S. A.), Limited, have received a cable from certain British firms who are large consumers of manganese ore asking if the Company is prepared to resume negotiations with them. These firms have all along shown a keen interest in the fields, and their engineer inspected the properties early in 1926. Negotiations with these firms are proceeding. In the meantime conversations with the Government and the Railway Board are being continued. Prospecting on the Company's properties, it is declared, have more than confirmed the reports obtained by the directors of the almost unlimited supply of high-grade manganese ore.

Navigation of Yukon River.—The Yukon River is navigable for large steamers from its mouth to Whitehorse, Yukon Territory, Canada, a distance of about 2,000 miles. The only obstruction to navigation which steamers cannot overcome with their own power at all stages of water is at the Five-fingers Rapids, so-called from five rocks which stand up out of the water like the finger tips of some giant hand. No difficulty is experienced at these rapids during the greater part of the season, but at the period of extreme high water the fall, at one point, is just sufficient to lift the big stern wheel of an upwardbound steamer for a few seconds out of the water. That brief space of time is sufficient for a ship to lose headway and be carried downstream. To overcome this, when steam navigation was first undertaken on the river, an improvement was made by which a steel cable was attached to suitable ring bolts in rocks above and below the rapids and the cable itself allowed to lie slack in the water. When steamers bound upstream reach the foot of the rapids the cable is taken on board and looped around a steam-driven capstan. As fast as the steamer pulls herself up river the slack or lower end of the cable is paid out overside into the water again. Once the critical point in the rapids is passed the cable is cast off into the river bed, where it is immediately available for the next steamer bound upstream.

The Trans-Saharan Railway.—The first step towards the construction of the railway across the desert of Sahara has been taken by the French Government deciding to carry out the preliminary surveys at a cost of twelve and a half million francs. This is the result of the persistent efforts which have been made by the Trans-Saharan Committee, an influential private body, to bring home to all classes of the community the advantages of connecting up North Africa with the Niger Valley. The undertaking appeals strongly to the public because it offers the only really effective means of linking up the vast African Empire with the Mother Country. Instead of entrusting the preliminary survey to a private company, as was originally intended, the Government has decided to form a Trans-Saharan Office, which will group engineering, financial and other experts appointed by the State, and it is expected that all details will be completed in time to permit of the Office starting work in October next and presenting its report six months later. So much has already been done in the way of surveying different routes across the desert that the office will have plenty of data to work upon, and should the report be favourable the Government will place the construction and working of the line in the hands of a company which will probably be formed by the leading railways. About one-third of the capital for the preliminary survey will be provided by the State and the remainder will be contributed by Tunis, Algeria, Morocco, and West Africa and by the P. L. M., Paris-Orleans, and Midi companies.

Trial Trip of the M. S. "King Edwin."—Satisfactory trials were run at the end of December of the single-screw motor cargo vessel "King Edwin," which is the second of nine similar vessels ordered from Messrs. Harland and Wolff, Limited, of Belfast, by the King Line, Limited. She has been constructed to comply with Lloyd's 100 A. I. class, with a straight stem and cruiser stern, and her principal dimensions are :—Length, 400 feet; breadth, 54 feet 6 inches; and depth, 34 feet 8 inches; the gross tonnage being 4,536 tons. The hull is divided by bulkheads into eight watertight compartments, the cargo being carried in five holds and handled by two derricks worked by two 3-ton electric winches. The double bottom extends the whole length of the ship, and is arranged for carrying oil fuel, lubricating oil, fresh water and water ballast. The propelling machinery consists of one six-cylinder four-cycle single-acting Harland Burmeister and Wain Diesel engine, fitted with forced lubrication, oil also being used for the piston cooling, while the cylinder jackets are water-cooled. A three-stage compressor is mounted at the forward end of the engine, and driven off the extension of the crank-shaft, to supply air for the fuel injection; manœuvring air is stored in two steel reservoirs at a pressure of 350 lb. per square inch. All the engine-room and deck auxiliaries are electrically driven, and the vessel is heated electrically throughout; the necessary power is generated by three 65-k.w. sets, each driven by a two-cylinder four-cycle Diesel engine, fitted with a special compressor for charging the manœuvring air reservoirs.

"Experimental" Locomotives.—According to the "Railway Gazette" in times of less financial stringency it would have been possible, had matters advanced thus far, to have carried out experiments on a large scale with locomotives built in accordance with new principles, or embodying new and distinctive features aiming at improving their performance. The cost, however, of such work is to-day almost prohibitive, and consequently new ideas, many of them containing great promise, can only be proceeded with slowly. We note that in his Presidential Address to the Institution of Locomotive Engineers Mr. Gresley specially touched upon this point, remarking that British locomotive designers and builders work under disadvantageous conditions compared with those of competitive nations. They have not at their disposal any facilities for carrying out experimental scientific reseach, nor can they obtain the necessary financial assistance to do so. Great credit is, therefore, due to those enterprising individuals and firms who at their own expense have produced locomotives with radical alterations in design and construction. With the industry in its present depressed condition, however, they cannot be expected to do much in the near future, for the reason that they cannot afford it. Railway companies are in a similar position, and have not the funds necessary to build experimentally what may prove to be failures. British railway engineers produce improvements by a sort of slow evolution. New features are tried and, if, successful, embodied in new designs. Progress is sure but it is very slow and the methods adopted in many cases are empirical rather than scientific.

French Tidal Power Schemes.—While the experimental tidal power station at Aber W'rach, near Brest, is making slow headway, another project is being put forward by a syndicate at Amiens, which proposes to create a station in the Bay of the Somme where the amplitude of the tides is declared to be sufficient for the purpose. The scheme, which has received the approval of the Chamber of Commerce of Abbeville, is said to be capable of producing a continuous supply of electrical energy varying from 40,000 to 120,000 horse-power. It was only possible to put the Aber W'rach installation in hand with the aid of a State subsidy. Until that venture shows definite results it is doubtful whether sufficient private financial aid will be forthcoming for a new scheme. Moreover, the attempts to utilise tidal power only seem justified in cases in which there is no local supply of energy, and the electrification schemes now being carried out in the Alps, Pyrenees and Massif Central, in conjunction with thermal plants in the Loire, Paris and the Nord, are intended to provide the whole country with energy, with the possible exception of Brittany, which is far away from the sources of supply. As the range of tides on the Brittany coast is far greater than elsewhere, it is only natural that an effort should be made to utilise a fraction of the energy available, especially where the coast permits of arrangements being made to store water against a falling tide, and the experimental Aber W'rach scheme, in which the tides and the river are employed to produce a continuous supply, offers a reasonable chance of producing satisfactory results, but it will only be the first stage of an experiment which will be continued for, probably, many years before definite data can be acquired concerning the economy and practical character and the limitations of tidal power schemes.

General Articles.

PROPOSED DESIGN FOR AN EARTHQUAKEPROOF TEMPLE AT MELA-GOPINATHPUR, DISTRICT BOGRA, BENGAL.

By A. K. DATTA., B. E., C. E., A. M. I. E.,
Consulting Engineer.

ABOUT 30 years ago there was a very severe earthquake which wrecked many big temples and buildings in the district of Bogra, Bengal. The famous old temple of Mela-Gopinathpur is one of them. The name of the village is after the name of the temple of Gopinathji. Every year there is a big fair, or *mêla*, at Mela-Gopinathpur in honour of the deity, Gopinathji, of the temple.

The heavy earthquake practically levelled to the ground the old big temple, which was about 400 years old, built about the time of Chaitanya Dev.

The authorities of the temple were collecting funds for several years past for reconstructing the temple in a way that it might not come down again by an earthquake.

Designs had been prepared in May last, reproduced on the opposite page, and materials are being collected now for starting the work of reconstruction of the temple.

This time the temple will be a strong reinforced brickwork structure resting on a reinforced brickwork concrete base, all parts being connected together by strong links of reinforcing steel rods, embedded in cement brickwork. The upper part above the base has been designed on the principle of a cantilever. Bonded cement plaster has been provided throughout the facings so that the facework may require least repairs afterwards and may be free from saltpetre action.

By the side of that temple another broken temple is still standing with half part of the shekhar intact and the other half crumbled to the ground as a result of that earthquake.

The writer was much interested to see in some engineering journals the description of "a concrete church to be built at Hednesford to withstand earthquakes and that will be the first in England designed to withstand earthquakes."

The writer is glad to find that a similar trial is being made in India at Mela-Gopinathpur (District Bogra), to make a temple earthquakeproof by using reinforced brickwork. Time will show how these buildings stand the tests of heavy earthquakes.

FACTORIZATION.

II.

COLUMN $\frac{l}{y}$ = L in Table B refers to Gordon's observed v in the Gordon Sections of observation, and has no reference to V_0. This must carefully be remembered.

The writer has satisfied himself, and seeks confirmation from engineers all over the world, that, in a CONSISTENT SERIES of V_0, in which the factor f_p is a constant:—

(*a*) l_p is probably a constant for all such V_0. c, in the formula, $v = c \tan \theta$ is therefore a constant for all $v = V_0$, as above.

(*b*) V_0, in the consistent series aforesaid, varies: (*i*) as $\sqrt{m_p}$; therefore (*ii*) as $\sqrt{y}$, f_p being a constant throughout; and (*iii*) finally as $\sqrt{d}$, in the same condition.

The problem of the CRITICAL MEAN VELOCITY in Earthen Canals and Channels, is solved in the simplest manner possible. Granted that one value of V_0, for one corresponding value of f_p, is known with absolute certainty, then in the same conditions of flow equality which have often before been set forth in INDIAN ENGINEERING, all other values of V_0, to the same constant f_p, can be determined by the ratio of $\sqrt{d}$.

Refer to Table A. The V_0 for Section No. 1 is $C_0\sqrt{m_p}$; and m_p, by the Composite Section Equation $= f_p$, that is 2·500; and V_0 for this Section No. 1 = 1·58113 × C_0, whatever value may be assigned to C_0.

The m_p for the sections in order are 2·500, 3·333, 4·167, 5·000, and 5·833. A few easy calculations show that V_0 varies as $\sqrt{d}$ throughout.

If now in Table B, in the second part, f_p throughout is made a constant 2·927, and m_p is corrected accordingly, the revised V_0 will be found to vary as the $\sqrt{37} : \sqrt{39}$, and so on, for each V_0. The reader can verify this at once for the references Nos. 3113, 3114, 3115, and 3120, in each of which f_p is very closely = 2·927.

As regards l_p being a constant, the same four references are tested in the following table by Barnes' two formulæ for earthen channels.

TABLE C.

REF. No.	BARNES' *i*		KUTTER'S *i*	
	Approx. 0·000	Exact. 0·000...	N =	N =
3113	...10073	...10314		
3114	.. 09863	...10104		
3115	.. 09668	.. 09885		
3120	...08860	.. 09097		

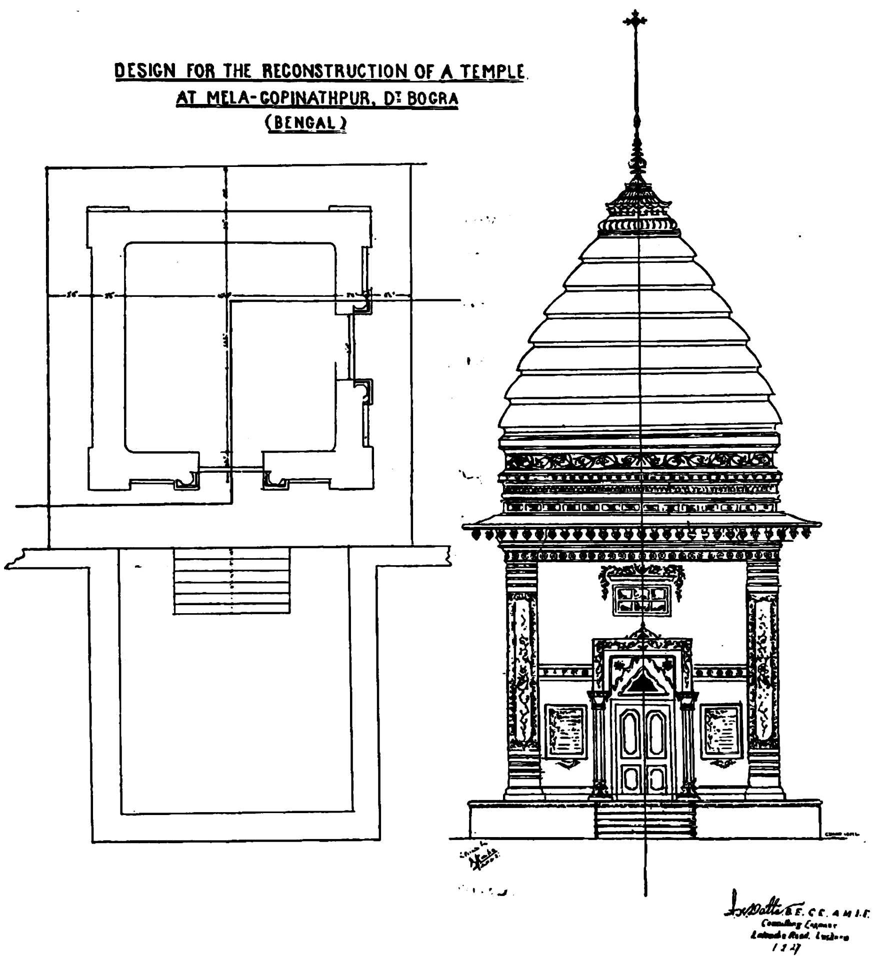
The blank columns for Kutter's *i* are provided in case any reader (who possesses, what the writer does not, the necessary Kutter's tables) desires to fill them in. In Barnes' exact data, the angle *i* varies from about 21¼ seconds to about 18¾ seconds in inclination of slope, that is: from about one in 9,696 to about one in 10,120. The difference in the two lengths of slope is 424 feet, 4·4 per cent.

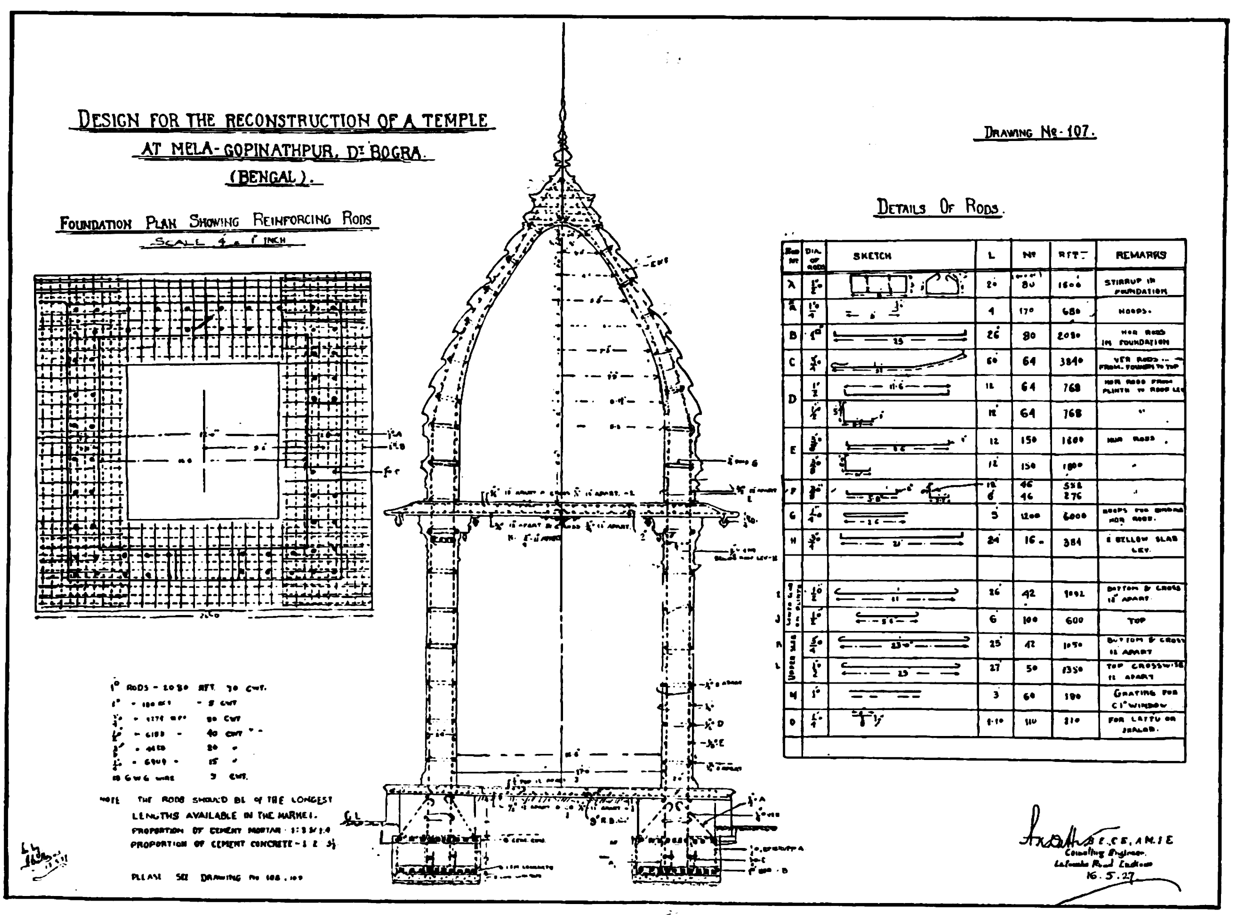
If the slope or fall be taken to be uniformly (for Table C) the mean, or 1 in 9908, then, by the equation $V_0 = C \tan \theta$, the value of C for reference No. 3113 is, 122·806 and for No. 3120, it is also 122·806, the log result in each case being 2·089220. It is on this, and precisely similar results with other similar data, that the writer bases his assertion that l_p in equal conditions is a constant for all connected V_0. If the discovery is confirmed, the results are of the greatest importance.

TABLE D.

REF. No.	$= 1·234\sqrt{m_p}$		$= 0·95\, d^{·57}$	
	V_0	f_p	V_0'	f
3113	7·413	2·927	7·440	2·949
3114	7·610	2·927	7·667	2·971
3115	7·803	2·927	7·889	2·992
3116	7·994	2·929	8·106	3·012
3117	8·182	2·932	8·319	3·031
3118	8·362	2·932	8·528	3·049
3119	8·533	2·929	8·733	3·067
3120	8·703	2·927	8·934	3·084

Table D compares the P. K. V_0 with the V_0[b] obtained from the Burma derived Kennedy Formula.





PROPOSED DESIGN FOR AN EARTHQUAKEPROOF TEMPLE AT MELA-GOPINATHPUR, DISTRICT BOGRA, BENGAL.

Since $V_o : f_p :: V_o^1 : f$ it has been possible to add a column of f values. No less than 5 of these *exceed* 3·000, *and f is only 3 when x is infinity*. It can therefore be asserted with confidence that if the true critical mean velocities for the Gordon Sections are all V_o, the values of V_o^1 are without exception scouring velocities, enlarging the Sections sooner or later to some more "stable" f. Yet V_o^1 for No. 3120 exceeds V_o by only a little over 2½ per cent. The facts could not have been disclosed without factorization; and it is interesting to meditate upon what more might be done in other sciences, *and in all branches of engineering*, by making "factorization" itself a scientific study.

Let us now go back to the second part of Table B, and make W throughout the major diameter of an ellipse, the minor diameter being a constant 6 units (2 × 3), and therefrom deduce the new f^{11} and V_o^{11}.

TABLE E.

REF. No.	W	f^{11}	V_o^{11}
3113	286·1	2·121	6·310
3114	285·4	2·121	6·478
3115	287·6	2·121	6·643
3116	293·6	2·121	6·802
3117	307·0	2·121	6·959
3118	305·1	2·121	7·113
3119	295·1	2·121	7·261
3120	285·8	2·121	7·408

From which it would appear that the Gordon Sections, if subjected respectively to the above V_o^{11}, would scour out to perfect semi-elliptical sections, all having a practically constant (slight differences in fourth places of decimals) f^{11}.

The PYRAMID KENNEDY FORMULA would appear therefore to be only an indication of what the hydraulic engineer can do with v, if he uses it as an engineering tool to mould earthen channels to any desired outline.

To each semi-ellipse a Pyramid Section, with side-slopes 5 : 3 can be es-scribed. The next article shows the issues.

Σ. Φ.

29th December 1927.

THE WATERWAYS OF BRIDGES.

THERE are two points in Mr. Farrant's article on the Waterways of Bridges in your issue of the 19th November last that call for attention.

The first is:—He produces a new formula for the maximum flood section of a river and compares its results with those of my formula as presented in the series of nine articles published in INDIAN ENGINEERING in 1926.

The second point is:—He has made some remarks about a comparison that was invited in those articles, between the cases of the Adamwahan Bridge on the N.-W. Railway and that over the Gunjal on the G. I. P. Railway.

Taking the second point first. As he says, the Adamwahan Bridge with its 16 spans of 250 feet each has to pass 220,000 cusecs in maximum flood, whereas the Gunjal with its 8 spans of 73 feet each, passes 300,000 cusecs. He calculates that the latter in order to pass this volume at a velocity of 14 feet per second must have an average depth of water passing under it of 37·7 feet and he comments on the state of affairs that would arise if such a volume of water came. It is not clear whether he thinks it impossible, but in any case, anyone interested should get hold of a copy of the Proceedings of the Institution of Civil Engineers for the year 1868 and read Mr. A. W. Howden's paper which was discussed at that Institution on 4th February of that year. It is an exceptionally interesting paper and describes and illustrates exactly what happened in the 1864 and 1866 floods at the Gunjal and other bridges. The maximum depth in the 1864 flood in the Gunjal was 44·8 feet above low water level and the standing wave was 6 feet, or more, high.

Mr. Farrant adds that the bridge must have been barely half as wide as it should have been (which is doubtless more or less true) and that heading up to anything like this extent could not have been contemplated at Adamwahan.

Now it is not clear what is the intention of this comment for of course very little heading up could be permitted at Adamwahan.

The comparison between these two cases was invited in my articles (*vide* p. 69 of INDIAN ENGINEERING for 31st July 1926 and p. 235 of 24th April 1926) not for the purpose of comparing the bridges, or the action of the flood in passing through them, a subject outside the purpose of my articles, but for the sole purpose of showing that the mere *size* of the catchment was no criterion of the flood discharge that might come from it —that a bigger discharge actually came from the 706 square miles in the Gunjal than from the 49,000 square miles that fed the Sutlej at Adamwahan. In the second of the two articles quoted above the comparison was made in the course of an argument, showing the futility of a formula for S or D which takes into account *only* the area of the catchment.

This brings us to the first point of Mr. Farrant's article, for the formula he proposes is a formula for S which takes into account *only* the area of the catchment, exactly as Dickens' formula did. It cannot hope therefore to give results anywhere near the truth for the reasons given in my article in your issue of 1st May 1926.

But how does Mr. Farrant arrive at this formula? He proceeds as follows:—He accepts Craig's original assumption and like Craig makes no attempt either to explain or to justify the same; then from this assumption he produces the formula by simple mathematical deduction, a most dangerous process that nearly always comes to grief.

What now is Craig's original assumption? As stated in my ninth article (*vide* p. 96 of INDIAN ENGINEERING of 14th August 1926) it is:—that the contribution to the discharge at the discharge point from any element of the area in the catchment is the *amount* of water falling on that element divided by the time taken to flow to the discharge point. This is undoubtedly Craig's assumption—and with all deference I am bound to say that as it stands it is mere foolishness.

Lest it should be thought that the above misrepresents Craig, we may refer to his own paper in the Proceedings of the Institution of Civil Engineers for 1885. On the second page he says:—

Quantity of water falling upon it (the element of area) under a rainfall of i inches = (say R)
Mean distance of the (element of) area from the discharge point = (say E)
Mean velocity of the drainage towards the discharge point is V
Time taken to reach the discharge point is therefore ... ... E/v
Rate of discharge from the element of area taking C as a coefficient = ...CR ÷ E/v

This is his assumption and it will be seen that it agrees with the above statement. From it, without explanation or argument, Craig deduces his formula, making (we must remember) a serious error in integrating his main expression, which he tied up into knots by unnecessary complications.

Mr. Farrant does not state Craig's assumption quite so clearly but it is the same thing.

Here it is in Mr. Farrant's words:—

"Craig......assumes that this triangle is covered to a depth of i inches with water—i is the number of inches

of rain which actually falls on the catchment basin is the definition given with the formula. He also assumes a velocity v for the water and by doing so *fixes the discharge* rate."

Mr. Farrant then proceeds to present Craig's steps of mathematical deduction, mistakes and all, arriving at Craig's well-known formula from which by an ingenious manipulation he arrives at his own proposed formula, *viz.*, $A = \frac{S}{440} = 3\ M^{0·43}$

Returning now to Craig's assumption.

How on earth can the volume of water that falls on an element of area during the period of a storm of i inches, divided by the time (t) that a drop of that water occupies on its journey to the discharge point, give the rate of discharge or anything of the sort!

If now instead of the time (t) we took the time (t^1) which the whole of that volume of water took to *pass* the discharge point once it had got there, it *would* give us some sort of a rate of discharge, but there is no relation between t and t^1, neither is t^1 ascertainable.

Of course the mistake in Craig's assumption lies in taking i as the *quantity* of water falling during the rainstorm instead of the *intensity*—the total rainfall instead of the rate per hour of the maximum downpour.

Once we accept i as the *rate* of rainfall we can argue as follows:—

Water cannot *flow off* an element of area faster than the rain *falls on* to it, and on the other hand if the water is not *running off as fast as it falls on* to the element of area then there is an accumulation of water going on and in that case we should not be getting the maximum rate of discharge. *Hence the maximum rate of discharge from an element of area is equal to the maximum rate of precipitation on it.* As however the element of area is some way off the discharge point (distance varying from O upwards of course) this water does not necessarily pass the discharge point at the moment of maximum discharge from the whole catchment. In short there are various reasons why the distant elements do not contribute to the maximum discharge at the discharge point the full rate that the water runs off the element itself—*vide* pp. 249-250 of INDIAN ENGINEERING of 1st May 1926 where it is shown that the proportion of the discharges from the various elements, throughout the catchment, that is effective, varies inversely as the distance from the discharge point.

It is therefore necessary to multiply by a factor varying inversely as the distance of the element of area from the discharge point. Hence the contribution to the maximum rate of discharge at the discharge point from the element of area dw is $i\ dw \times \frac{k}{y}$, i being the *intensity* of fall and y the distance from the discharge point. And from the whole area the maximum rate of discharge $= K\int\frac{i\ dw}{y}$.

This is the same as Craig's original assumption *except that* i is understood to be the *intensity* of the rainfall—so many inches per hour—and not the *Quantity* of fall; and y is the distance instead of the time; for as Craig takes the rate of flow over the catchment from all elements to the discharge point as the same v, the time and distance are interchangeable being a fixed value in relation to each other.

With this correction made I am afraid Mr. Farrant's deductions fall to the ground, and with them the formula he puts forward.

In any case it is certain that a formula giving S as a function of M_n alone cannot even remotely approach reliability.

In conclusion I may be allowed to say that I cannot share Mr. Farrant's opinion that my figures for the bridges on the Ondal-Sainthia Chord Railway are too small; not even in the case of the Adjai. The apparent discharge of 200,000 cusecs in that river was the result of the bridge being just below a sandbank which set up eddies. Part of the waterway of the bridge was occupied by water coming back. The formula gives the more correct figure for that bridge.

I have tried repeatedly to persuade those sufficiently interested in the subject to read my articles, to realise that "*observed* discharges" must always be distrusted until they have had at least as much examination as the result of a formula calculation.

G. E. L.

KARACHI'S WATER SUPPLY.

NEW CHLORINATING PLANT.

AT the invitation of Dr. E. D. Shroff, L.R.C.P., and. S. E., D. P. H. (London), Health Officer of the Karachi Municipality, a large number of Municipal Councillors and a few other interested gentlemen and Press representatives attended the opening ceremony of the new chlorinating plant at the Sydenham Reservoir on Saturday the 4th instant. Arrangements for conveying the visitors by motor cars had been made at the Municipal Office.

The opening ceremony was performed by Mr. Jamshed N. R. Mehta, the President of the Municipality.

The whole assemblage having taken their seats, Dr. Shroff made an interesting speech, in the course of which he reviewed the history of the water supply in Karachi and made a special reference to the sterilizing of water and the disappearance of cholera. He said:—

"It is not my intention to inflict upon you a long speech but I shall, with your kind permission, briefly give the history of the sterilization of Karachi Municipal water supply. During the Great European War, the military authorities had established a Bacteriological Laboratory in Karachi which was attached to No. 37 Indian General Hospital. The Laboratory was placed under the charge of Major Greig, one of the eminent Bacteriologists. Through his kind courtesy I used to take advantage of this laboratory and samples of Municipal Water were frequently analysed at this laboratory. In previous years, as there was no laboratory in Karachi, samples of water had to be sent to Bombay for analysis. In the first week of September, 1917, as usual rain fell in Karachi. Prior to this rainfall, samples of water were analysed and nothing abnormal was found, but after rainfall, when the Malir River came to flood, samples were again taken and sent to Bombay for analysis and at the Laboratory attached to No. 37, Indian General Hospital, and to my horror, a report was received that the water contained cholera germs like Vibrios. I immediately consulted Mr. Measham Lea, then Chief Officer and Chief Engineer, and under his able guidance we were able to start the chlorination of water supply within 24 hours after the receipt of the laboratory report. As it was the time of War, great difficulty was experienced in obtaining the bleaching powder required to sterilize water, and before I could get a supply from Bombay I had to collar bleaching powder lying with washing and dyeing firms in Karachi. Messrs. Nusserwanji and Co., who had their Laundry, helped me considerably by supplying bleaching powder on the spot.

Prior to the year 1917 we used to get frequent epidemics of cholera in Karachi, particularly after rainfall, but it is noteworthy to mention now that since we started sterilizing water in 1917, there have been no epidemics of cholera in the city. We had a small outbreak of cholera in 1921, in the Trans-Lyari Quarter, which is on the other side of the Lyari River, in the village called "Golimar," and which is situated in the close vicinity of the Sewage Farm. The inhabitants of this village used to drink well water infiltrated with sewage percolating into the soil. As there was no

Municipal pipe water available, arrangements were made to supply this village with pipe water, and the wells were closed.

Bleaching powder is unstable; it originally contains only about one-third by weight of available chlorine which small proportion is rapidly reduced during storage, particularly, in damp and warm climates. This being so, it is necessary, for accurate and precise treatment, to ascertain the actual chlorine contents of the reagent at regular intervals during the sterilising process. Consequently since 1923, pure chlorine in gaseous form is used to sterilise the water supply. Messrs. The Paterson Engineering Company have installed their Chloronomes in a large number of cities in Europe and India, and now Karachi is one of them.

The Chloronome measures the reagent volumetrically. The chlorine, discharged from the cylinder, passes through a connector valve which is coupled to the valve on the cylinder head. The gas is led through a flexible connecting copper tube to a chlorine filter, to arrest any slight deposit which may be carried by the gas from the coil tubes or the cylinder fittings. As the pressure of the gas leaving the cylinder is much too high for accurate measurement and administration, it is necessary to reduce this pressure. In order to ensure a constant low pressure on the regulating valve pressure-reducing valves are arranged in series. The chlorine gas at a pressure varying from 80 to 120 lbs. passes through the first valve, which reduces the pressure to 20 lbs. per square inch; then through the second valve which maintains a constant pressure of 10 lbs. per square inch on the regulating valve. Should this pressure drop, the attendant knows it is time to connect a fresh cylinder. By the application of artificial heat it can be assured that the first cylinder is completely exhausted before being replaced by another. The chlorine gas passes the regulating valve and flows from the meter through a suitable down pipe nearly to the bottom of the absorption tower. This glazed earthenware tower is fitted at the top with a water distributing tray, and packed with pumice. A small trickle of water is uniformally distributed over the pumice, and in its downward flow absorbs the measured quantity of chlorine gas. The chlorine solution so formed flows from the bottom of the tower through a chlorine-resisting rubber pipe and is distributed through the main volume of the water to be disinfected.

As we generally get taste and smell of chlorine in water, with a view to make water palatable, we have now installed another similar plant to de-chlorinate water, and we hope that the public will have no cause to complain in future. The water supply will be de-chlorinated with sulphurous acid gas, whenever necessary, after analysis of water.

From these facts I feel confident, you gentlemen will agree that the sum of Rs. 16,000 spent on the plant is spent in the right direction.

I am known as a habitual and professional beggar, so before I conclude, I have one request to make to the Karachi Municipality, and it is to install the latest type of high combustion destructor for the city, for which I have been harping for since I joined the Municipality in 1912. Then alone we can rightly take pride in possessing the latest sanitary appliances for the public health of our city.

With your permission I now request our worthy President, Mr. Jamshed N. R. Mehta, to open the new chlorinating plant with his usual blessings, which always come to be true.

Mr. Jamshed N. R. Mehta then offered a few remarks and referred to the importance of this growing cosmopolitan city in which there is an increase in the birth-rate to the extent of "50,000 souls every ten years." He said that water to Karachi came from a distance of 24 miles and measures ensuring the sanitary conditions and purity of water were necessary as there might be many factors which might be responsible for spoiling water. But science had come to the aid of the world and they were taking advantage of up-to-date scientific methods.

The world wanted health and happiness and it was their aim to have both. As regards the Destructor, for which Dr. Shroff had made a special request, he would tell them that he was himself thinking of its necessity since a long time. About two hundred tons of refuse were collected every day in Karachi. The Destructor would cost about four lakhs of rupees, and the scheme would come before the Corporation in due course of time.

The President then repaired to the Chamber, where the chlorinating plant had been installed and turned the regulator valve and duly declared the plant open.

Mr. J. H. Thomas, M. I. Mech. E. M. I. E. (Ind.), the representative of the contractors, Messrs. The Paterson Engineering Co. (India) Ltd., was present and after the President duly declared the plant open, explained the various features of the plant and its process to the whole assemblage.

Dr. Shroff then invited the assemblage to an "At Home." All the visitors sat in a pavilion, where they did full justice to the refreshments.

Mr. Allahbux Khudadkhan Gabol, on behalf of himself and others present, thanked Dr. Shroff for his generosity and hospitality. They were much impressed with what they had personally seen and he hoped that their good doctor would organize many more such functions. He also thanked Mr. Jamshed N. R. Mehta, the President, for kindly coming to perform the ceremony.

Dr. Shroff then garlanded Mr. Jamshed Mehta and presented Mr. Ghulam Hussein Kassim with a floral bouquet.

The party on their return journey visited the de-chlorinating plant.

MODERNISING COLLIERY MACHINERY.

THE largest electric winder installed in Britain is an equipment of 3,000-7,500 h.-p. at the Parkgate No. 3 pit of Grimethorpe Colliery, near Doncaster, which is owned by the Carlton Main Colliery Co., Ltd., of Barnsley.

The equipment, which was supplied by the Metropolitan-Vickers Electrical Co., consists essentially of a double-unit d. c. motor, direct-coupled to the winding drum and controlled on the Ward-Leonard principle and a flywheel motor generator set by means of which power is taken at 3,000 volts 50 cycles a. c. from the colliery company's power station and supplied as direct current at 1,000 volts to the winder motor.

The shaft at which the equipment is installed is a new one, and the winder was first used for sinking operations. The main working conditions to which the winder was designed are as follows :—

Depth of shaft, 2,610 feet.
Weight of cage and chains, 17,196 pounds.
Weight of one tub, 728 pounds.
Net load of coal per cage, 14,780 pounds.
Output per hour, 300 tons.
Type of rope, locked coil.
Diameter of rope, 2 inches.
Type of drum, bi-cylindro-conical.
Small diameter of drum, 16 feet.
Large diameter of drum, 26 feet.

The two winder motor-units are disposed on either side of the drum; they are open type machines with commutating poles and separately excited shunt field. Each unit s 13 feet 4 inches in diameter and weighs 67 tons.

They operate at 49·6 r. p. m. in series connection on a 1,000 volt supply from the motor generator set. The normal h.-p. / time diagram for the motor gives a

striking indication of the effect of the flywheel in eliminating the peaks so as to obtain an approximately constant load demand throughout the wind. The set is capable of dealing with a maximum peak of 7,500 h.-p. and of sustaining an overload of 25 per cent. for two hours. The connections of the machines are so arranged that in case of emergency the winder can be driven by one motor and on the supply from one generator of the motor generator set.

The motor generator set, with its exciter set, consists of a slipring induction motor of 1,540 h.-p. driving two 1,065 k. w. 500 volt direct current generators connected in series, and a solid steel flywheel of 23 tons weight and 12 feet diameter, mounted between the generators. The induction motor is of the open protected type with inside sliprings and brushgear suitable for continuous running. Its synchronous speed is 750 r. p. m. The generators are of the open compensated type. Their overload capacity after six hours full load run is 25 per cent. for two hours, or a momentary peak of 4,240 k. w. total for the two machines.

The flywheel is of the Metropolitan-Vickers special disc type, of cast steel. It is unpierced at the centre, being carried on two jack shafts which are attached to the wheel by spigotted flanges, arranged so that the torque is transmitted through keys and not through the fixing studs. The wheel is provided with a planished steel guard over its upper part, while the lower portion runs in a pit in the foundation. In this way air resistance is reduced to a minimum. The energy delivered by the wheel during a 15 per cent. drop in speed is 45,000 h.-p. seconds.

The set is mounted on a combination bed-plate and the shafts are joined by rigid couplings. The combined shaft runs in five pedestal bearings, of which those for the flywheel are provided with forced lubrication and the others are ring lubricated. The set is provided with a centrifugal overspeed prevention device. This consists of a plunger fitted in a diametrical hole in the end of the shaft and governed by a spring so that when the speed exceeds a predetermined limit the plunger flies out and operates a small auxiliary switch which is connected in the trip circuit of the equipment, and the set is brought to rest.

The exciter set consists of two 500 volt d. c. generators driven at 725 r. p. m. by a 3-phase squirrel cage motor operating on a 440 volt 50 cycle supply. One generator is of 32 k. w. capacity and provides the excitation current for the two winder motors, the other is of 13 k. w. capacity and provides the excitation of the two d. c. generators. The three machines are mounted on a common bed-plate and rigidly coupled.

For controlling the motor generator set a combined automatic slip regulator and starter is installed. The amount of resistance in the rotor circuit is automatically varied in proportion to the load on the induction motor so that when a sudden overload of short duration is experienced the motor is permitted to drop in speed and the flywheel to give up sufficient stored energy to deal with the peak. The induction motor is thus protected from violent momentary overloads and the demand from the line is kept practically constant.

The slip regulator is of the liquid type, automatic movement of the electrodes being effected by the action of a torque motor. This device is mechanically coupled to the operating gear and supplied with current from the secondaries of series transformers connected in the three phases of the supply to the induction motor. Thus any tendency towards an excessive current is communicated to the torque motor, and produces the necessary movement of the electrodes.

When hand operation is required, as, for instance, when the regulator is being used as a starter to start up the set, the automatic feature can be cut out by short-circuiting the series transformer secondaries with a switch provided for the purpose.

The control system for the winder motors is so arranged that regulation is carried out in the field of the generator exciter, thus obviating the necessity of handling a powerful field on the Ward-Leonard controller. The controller is of the Metrovick face-plate type with resistances constructed on the unit principle. The spindle is mounted in ball bearings, and is operated by means of a lever system from the control cabin.

Incorporated in the control system is a complete system of safety devices which ensures that the acceleration and retardation of the winder are carried out at the correct rates, and that the compressed-air brakes will be applied in the event of any abnormal conditions which might endanger personnel or equipment.

The first of these devices is the cam gear which positively prevents the driver from accelerating too rapidly while allowing him at will to reduce the rate of acceleration or to maintain any speed within the safe limits for which the gear is set. Towards the end of the wind it returns the control level at a predetermined rate towards the off position, so that it is impossible for the cage to reach the bank at more than creeping speed. In the event of the cage being allowed to pass the decking level, an overwind trip which is incorporated in a Lilly controller cuts off the excitation and causes the brakes to be applied, a similar effect being produced if the driver attempts to start in the wrong direction. The Lilly controller also protects the winder against overspeed at any portion of the wind, and gives warning of the correct time at which retardation should commence. Contingencies of the overload on the winding motor, or failure of its field, overspeed of the motor generator set, or failure of power supply, oil feed or air supply, are also provided for by automatic tripping of either the winder safety circuit or the main oil switch. A hand operated trip switch is also provided for the driver's use in case of emergency.

The incoming 3,000 volt supply is taken to a switchboard comprising two sheet steel cubicles, one of which controls the supply to the induction motor of the main motor generator set, and the other to a transformer which provides a low tension supply to such auxiliaries as the exciter motor and the motor driving the air compressor for the brakes. The d. c. and low tension a. c. switchgears are mounted upon a panel type switchboard which also accommodates the relays and other details of the protective equipment.

The makers of the mechanical parts of the Winder were Messrs. Markham and Co., of Chesterfield.

The Gazettes.

Bihar and Orissa, February 8, 1928.

Irrigation Department.

Mr. Mohan Lal Bahl, Assistant Executive Engineer, is granted leave on average pay for two months, with effect from 1st February 1928, or from any subsequent date on which he may be allowed to avail himself of the leave.

Babu Manmatha Kumar Basu, Assistant Engineer, is granted leave on half average pay for one month and twenty-seven days, preparatory to retirement, in extension of the leave granted to him previously.

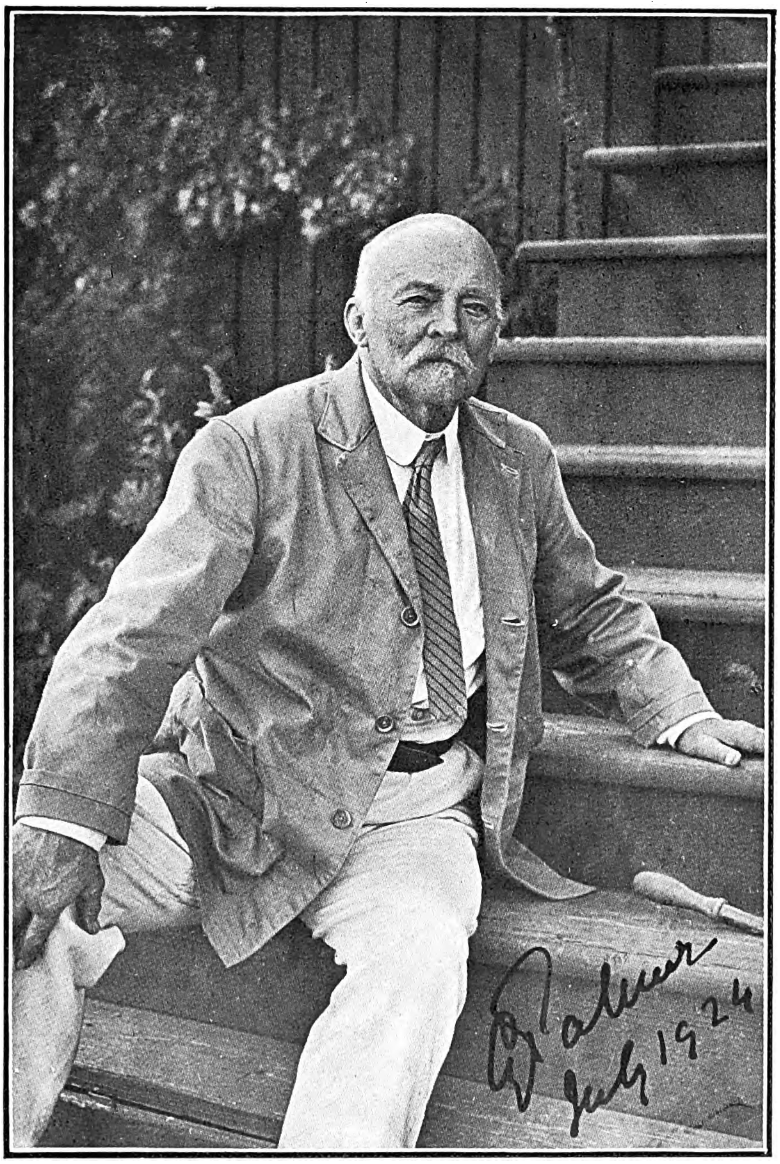
Punjab, February 10, 1928.

Irrigation Branch.

Mr. T. A. W. Foy, Executive Engineer, attached to the Bikaner Main Line Division of the Bikaner Circle, Sutlej Valley Project, is allowed leave on average pay for 8 months from 1st April 1928, or subsequent date.

Pandit Babu Ram, Assistant Engineer, on transfer from the Rohtak Division, Western Jumna Canal, joined the Panjnad Weir Division, 3rd Bahawalpur Circle, Sutlej Valley Project, on 4th January 1928, on return from leave.

Mr. J. D. H. Bedford, Superintending Engineer, 2nd Bahawalpur Circle, Sutlej Valley Project, took over charge of the 3rd British Circle, Sutlej Valley Project, of superintendence in addition to his own duties, on 25th January 1928, from Rai Bahadur Bawa Natha Singh, officiating Superintending Engineer, who proceeded on leave.



MR. C. G. PALMER, C. I. E.

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INDIAN ENGINEERING.

SATURDAY, FEBRUARY 25, 1928.

MR. C. G. PALMER, C. I. E.

I.

IT is interesting to recall that there is still living an engineer, late of the Public Works Department of India, who is entitled to wear the medal and clasp of the Mutiny of '57 ; and, unique as that is, it is not Mr. Palmer's sole claim to distinction. He did excellent work in the Irrigation Branch of the United Provinces in his day, especially during the famines of 1896 and 1897, when he earned the warm approbation of so exacting a Lieutenant-Governor as Sir Antony Patrick MacDonnell ; and distinguished he was in yet another way in that the cheeriness and geniality of his disposition made him a host of friends wherever he went.

Charles George Palmer, a son of the late General Henry Palmer, was born at Jalandhar in the Panjab on the 15th October 1847. His father was in the 48th Native Infantry, his mother died in January 1856, and the only member of the family with his father at the time, he went with the Regiment, which his father was then commanding, to Lucknow later in that year. A sister arrived from England shortly afterwards, and he had also at Lucknow a married sister with two children. On one day, as it were, there seemed to be no cloud upon the sky, on the next women and children were hurried off into the Residency, dread things followed very fast, there was the battle of Chinhut, and then the horrors of the Siege of Lucknow began in earnest. Mr. Palmer often said that he had never read an account of the Siege, his near view of it, as a small boy, was enough for him. His father commanded the small force that fell back on the Fort of Muchee Bhawan, but he had to evacuate it two or three days later in order to bring all available men, guns and portable stores to strengthen the main force at the Residency. On the second day of the Siege, Palmer, his married sister and children, his younger sister and others were in a small room in an upper storey of the Residency, and the children were having a meal. The French window of the room was barricaded with a wardrobe, the younger sister was attending to the children, and then came a crash and the room was full of red dust. A cannon ball had passed through the wardrobe and buried itself in the brick wall beyond. For a moment, Miss Palmer seemed uninjured, and then she fell mortally wounded. Her death was the first news her father heard as, to the sound of cheers, he marched in after his successful evacuation of Muchee Bhawan without the loss of a man or a gun. By the end of the Siege, Charles Palmer was the only survivor of the group in that little room.

After the first few days of disorder in the Residency, the defence settled down to fixed duties, and the small boys were set to grind wheat in the small hand-mills in use in the country. It was a job for which Palmer had

a great aversion, and he came to be attached to the battery of his cousin and brother-in-law, Captain Ralph Ouseley, as an ammunition carrier and messenger. In these duties he had to run across an open space, a zone of some danger, and for the part he played no one can say that he did not deserve the medal and clasp of the defence of Lucknow. He smelled powder and witnessed many scenes of tragedy of which he could give, from personal knowledge, graphic descriptions in his after-life, but there was one painful incident in particular which made a deep impression upon his memory. Havelock had arrived with his relief force, there were wild sounds of shouting and tumult in the direction of the Bailey Guard Gate, and Palmer running there found the pipers marching up and down, playing "The Campbells are coming." It was not on account of rejoicing, but to draw attention away from one of the most tragic mishaps of the Mutiny. The Highlanders, who had fought their way desperately through the streets, were temporarily held up at the gates, and when they burst through, one of them finding an armed Indian, apparently opposing him, bayoneted him before he could be stopped. The bayoneted man was a very gallant and loyal Subahdar who, seeing the consternation among his sepoys, cried out as he died: "It was in the confusion, my brothers, and it is of no consequence at all. I have eaten the Company's salt for forty years, and it is a little thing to die for it." With these noble words, there passed away a splendid Indian soldier.

On the final relief of Lucknow after the second siege, the women and children were sent to Allahabad in bullock shigrams, and thence Palmer, travelling by river steamer to Calcutta, sailed for England, arriving at Southampton in May 1858. In the autumn of that year, he went to King Edward VI. School at Sherborne, and his school life would not appear to have been very happy. The boys called him "sepoy," regarding him as the nearest thing to a mutineer they could conceive; and when public indignation was aroused at any fresh news of Mutiny cruelties, "Sepoy Palmer" was given a good licking as appropriate to the occasion. He found it useless to explain that nearly half of the defenders of Lucknow had been Indian sepoys, he had to take his licking, and the effect on him, as he used to say, was to increase his sympathy for the kindly Indians among whom he had spent his early days. Moreover, he suffered at school from asthma, and it was decided to send him back to India sooner than had been intended. He returned to India in a sailing ship from Glasgow round the Cape, and the skipper who pointed out the ship at Glasgow to his uncle and himself remarked with some pride: "Aye! She's a grand boat, she's all of 900 tons." He started on the 30th November 1863 and reached Calcutta on the 21st March 1864. From Calcutta he went to Meerut, and coached by a private tutor he passed the entrance examination of the Thomason College at Roorkhee in 1866. He was not a distinguished student at the College, he had not possessed any previous educational advantages, nor had the circumstances of his life led to robust health. He had fever at Roorkhee, bad dysentery, and he and a Sapper sepoy were bitten by a mad dog. There was no Pasteur Institute in India at that time, the sepoy died, and Palmer, whose wounds had been severely cauterised, may have escaped for that reason. He obtained his appointment to the Public Works Department, however, and in the autumn of 1868 was posted to Military Works at Chakrata. Early in 1870, he was transferred to Irrigation in the North-West Provinces and Oudh, as they were then called, and it was as an irrigation officer that he commenced the serious business of his life.

(To be continued.)

IRRIGATION IN INDIA.

THE Government of India review of irrigation for the year 1925-26 gives the results of the operations during the year concerned, with the usual statistical tables, in a concise and readable form, but without any features of outstanding interest. Irrigation depends so much on the character of the monsoon that the distribution of the rainfall always finds a place in the review. In 1925 the monsoon broke a little before the normal date, the rains were strong in northern India till the middle of August and less active than usual in the Peninsula. After the first fortnight of August, the monsoon withdrew almost completely from north-west India, but fairly good rain fell elsewhere in the second half of September. The aggregate fall of the season was below average by 4 per cent. The total area irrigated by Government works of all classes in British India was 28·1 million acres, which was nearly a million acres more than the area of the preceding year, and only a very little less than the record area of 1922-23. The Panjab, as usual, takes the top place with an area of 10,345,215 acres, Madras, also as usual, comes next with 7,112,062 acres, then Sind, and the United Provinces and Burma, in that order. The total capital outlay, direct and indirect, on irrigation and navigation works, including works under construction, amounted at the end of the year to Rs. 99·84 lakhs. The gross revenue of the year was Rs. 11,46 lakhs and the working expenses Rs. 4,06 lakhs. The net return on the capital expenditure was 7·41 per cent, The Panjab canals yielded 17·20 per cent., and in Madras the percentage of return was 12·17. The estimated value of the crops irrigated was about one and a half times the total capital expended.

Taking, therefore, the general aspect of irrigation in India into consideration, the results may be said to be a matter for congratulation. There have been successes, some very great successes, and there have been disappointments, but on the whole, seeing that the Government works irrigate about 13 per cent. of the entire cropped area of the country, giving a remunerative return on the capital outlay, affording in many tracts protection against drought and famine, and adding enormously to the agricultural wealth of the country, it is evident that the projects of the past have been

amply justified. The future is in some respects less certain; in places where irrigation was most wanted and where, when introduced, it was most profitable, there has been water-logging and there may have to be restrictions; and the newer schemes, because they often entail greater engineering difficulties and are inevitably more expensive for their scope on account of the enhanced costs of labour and materials, will not have the same financial productivity. The projects, known as those of the early post-war period, are likely to lead to considerable disappointment as compared with the anticipations claimed for them. Sind is no mean irrigation province; beyond the matter of climatic conditions which mean a constant demand for water it has not special advantages of the Panjab, as it is a tract deltaic to the Indus; but its inundation canals have served it well, and what was required for it was improvement, but not improvement on the lines of the Sukkur Barrage scheme and there is trouble ahead. The Sutlej Valley project of the Panjab, for which the grandiose claim was that it would rival the most remunerative irrigation work of India, the Lower Chenab Canal, has long since shown that it will do nothing of the sort. The Sarda project of the United Provinces holds out no great promise, and the Cauvery-Metur project of Madras will be lucky if it fulfils its financial expectations. There are other schemes mentioned in the Government of India review, but the above four are those which will be watched by a critical public, and on the results will depend much more than at present meets the eye.

THE METEOROLOGICAL DEPARTMENT OF INDIA.

II.

MR. FIELD, who succeeded Sir Gilbert Walker as Director-General of Observatories, is a Cambridge man, a trained physicist and electrical engineer with great mechanical ability. He had joined the Meteorological Department as Scientific Assistant in 1904, and foreseeing a great need he made a special study of upper air work in India. His first essays were so promising that he was eager to continue to progress to further developments, but want of funds hampered him and he offered to resign his appointment. The Royal Society had, however, brought the question of meagre budget grants to the notice of the Secretary of State, and in 1912 an allotment was made for upper air work. With this encouragement Mr. Field withdrew his intention to resign and built the Agra Observatory, which is an observatory, a factory for the manufacture of hydrogen, a workshop for making and repairing aerological and meteorological instruments and a parent station for various balloon observatories. The Agra Observatory was important from its very inception, but obviously it became far more important when it was known that aerial transport was coming east to stay, and India would reap the immense advantage of being on the direct Empire route to Australia. It was imperative that India should contribute to the progress that every civilised country considers is most essential in these times, it would have been almost criminal if she had held aloof, and Mr. Field was so engrossed with his work at Agra that he viewed the change to administrative duties at Simla with no great pleasure.

But that does not mean that Mr. Field was an indifferent head of the Department, his tireless industry enabled him to keep in touch with the scientific activities as well as with the administrative needs of his service, and he proved to be a very capable administrative officer, though from the beginning no such officer could ever have been entirely happy. Until there came a change in the time of Sir Basil Blackett, the Members in charge of the Finance Department of the Government of India were so apathetic to the great practical importance of meteorology that they might have been said to have suffered from the disease known as intellectual myopia. Many years ago, Sir John Herschel pointed out how important meteorology was as a science, it affects the cultivator, the seaman, the engineer and the health-officer, and in the interests of any country, especially a country like India, its researches are invaluable. Moreover, since Sir John Herschel made his very pertinent remarks, there has arisen the urgent need of meteorological information for aviation, whether by airships or aeroplanes. But the Finance Department, and even the Department of the Government of India responsible for guarding the interests of meteorology, would appear to have been unable to understand such considerations. The Director-Genera was therefore always short of funds and short of gazetted staff for the work he had in view. He often found that it was hardly possible to do more than maintain the routine work, as one Director-General said, "in a scrambling and unsatisfactory manner." Applications for money for special purposes, however urgently needed, met with a complete blockade. Finance Members, as a class, had no more use for science than Mr. Gradgrind had for originality, and to demands for funds there was one description of answer. If funds were given, it was desired to know what revenue would in return be contributed to the exchequer, and no meteorological officer could possibly make any definite promise in that respect. Every advanced country has long since recognised that scientific research work in the hands of competent scientists must, taking the long view, be fructuous; but outstanding results from new lines of work mean time, it may be five or twenty years or even longer. Money for research is not like money for buying a bag of seed to sow, with the certainty of a harvest in a few months. The Directors-General may not in the past have been sufficiently insistent; their long discipline in refusals of means had curbed their ambitions and made them hyper-critical of proposals involving expenditure; and with resignation, though not without earnestness of purpose, they settled down to do their utmost as far as their small allotments would permit them. They felt that any suggestion that twenty years of work in a specified direction would justify

the sum expended on it and would be an advisable course of action to take was, until recent years, seldom worth putting forward at all. It was partly for that reason that when money was tight the Meteorological Department suffered disproportionately, it had worked consistently at the extreme low limit of expenditure, and it could not stand a proportionate cut in the same way as a major department.

It is understood, however, that the broad-sighted views of Sir Basil Blackett have removed the money difficulty, and that the Department has now been placed in possession of sufficient funds for its operations. But very satisfactory as that improvement in the position is, the establishment question gives rise to some little apprehension. In the administration report for the year 1922-23 it was said: "In these days of criticism that Indianisation in the services proceeds at too slow a rate, it is worth while to note what has happened in this department. The policy of Indianisation was definitely adopted over two years ago and the personnel occupying the thirteen posts of the grades of Meteorologist and Assistant Meteorologist, of which there are three half-time appointments, has changed from 10 Europeans and 3 Indians in September 1919 to 3 Europeans and 10 Indians in March 1923. This change has not been helped forward by any retirement on proportionate pension for that privilege has been denied to this Department." The change from 10 Europeans and 3 Indians to 3 Europeans and 10 Indians in three and a half years is rapid Indianisation; and in 1927 the figures stood at 2 Europeans and 22 Indians. It is also to be noted that of the 2 Europeans, one is Dr. Royds who is on specialist solar work at the Kodaikanal Observatory, and therefore there is now only one British officer, Dr. C. W. B. Normand, to run the Department. Not for a moment is it implied that Indians are unsuited to the service, in mathematical and scientific subjects they have shown how accomplished they can be, and the Indian officers in the Department, on their academic qualifications, are no doubt as good as could be obtained anywhere. But there are other qualities that call for consideration, the Indianisation of this particular service has been overdone, and it would be disastrous if, with the recent increases in the lines of activity, anything were to occur to hinder Dr. Normand or to draw him away from India. There have been examples of needless losses of late, Sir Gilbert Walker with liberal treatment might have been induced to stay, Dr. Simpson, now Director of the London Meteorological Office, a very valuable man, was allowed to go, and then, when only Mr. Field was left of all the seniors, no effort was apparently made to retain his services. The Department has, therefore, at a time when its senior officers can ill be spared, suffered more than it can very well bear. But it has still Dr. Normand, and there ought to be no lack of appreciation in his case, and no failure to help him in a position of great responsibility and to keep him by all reasonable means. In the present circumstances, if his services were lost, it would be most unfortunate for the future of meteorology in India.

(To be continued.)

OCEAN LINERS.

MARINE engineering has always been very progressive since the time when the first steam boat, the little "Comet," was launched in the Clyde in 1812. The "Comet," though she would now be regarded as in the same category as George Stephenson's first railway locomotive, was a great event, so great an event that she has been called "the mother of modern British marine," and on the occasion of the centenary of this comical little steam-propelled boat, the 31st August 1912, a good deal was said about the later developments. The developments were indeed very rapid, steamers followed the "Comet" thick and fast, and in 1818 came the "Vulcan," the first boat to be built of iron. The thirties of the 19th century witnessed a great advance, and 1837 was the year of the "Sirius," the first British vessel to steam across the Atlantic, the journey taking about twenty days. In 1840, four ships, the first instalment of the Cunard fleet, took the water, and one of them the "Britannia" was 260 feet long, 740 horse-power, 1,100 tons, speed 8½ knots. Three years later, Brunel designed the "Great Britain" with a screw propeller, and in 1857, with a jump, came the "Great Eastern," 680 feet long, 30,000 tons. The jump was, however, too great for the time, and size was reduced, though great improvements continued. The "Scotia" of 1861 was only half the length of the "Great Eastern." In 1879, steel hulls were a new feature, and the "Arizona," a boat of this class, was 450 feet long. A few years later, there was an advance to over 500 feet in length and the compound engine was introduced. In 1893, the "Campania" had a length of 600 feet and the triple expansion engine came into use. In 1907, the "Lusitania" beat the "Great Eastern" with a length of 760 feet and did the Atlantic voyage in four and a half days. In 1911, just within the century from the "Comet" beginning, the "Olympic," with a length of 852 feet, astonished the world. The "Olympic" is the largest British-built ship, her dimensions are length 852 feet, breadth 92 feet, depth 59 feet, gross tonnage 46,439. She has accommodation for 2,610 passengers, and during the war she carried 200,000 troops across the Atlantic. A further point is that by that time Sir Charles Parsons had invented the turbine, and the "Olympic" was equipped with turbines and reciprocating engines in combination.

The advance in marine engineering from the "Comet" to the "Olympic" within a hundred years has therefore been very remarkable. But the "Olympic" was by no means the last word. The brochure of the White Star Line stated that the gross tonnage of the "Majestic" was 56,551 tons, about that of all the 132 ships of the Spanish Armada, the space of her cabins and engine rooms was said to be that of 400 houses of eight rooms each. She was built to carry over 5,000 persons, and it was said that if placed alongside the Woolworth building of New York, the highest building in the world, she would top its spire by 164 feet. The length of the "Majestic" is 915 feet, the length of the largest cathedral in England being 550 feet. And even that is not apparently the last word, for "The Times" states that announcements of immense general and technical interest by the two leading British shipping companies in the Transatlantic trade are to be expected in the not distant future. It is understood that each of these companies will construct a monster ship larger than anything yet afloat. The greatest gross tonnage possessed by any vessel at present is that of the "Leviathan," 59,957 tons, the present fastest ship of the class is the "Mauretania," and if all former records are to be dwarfed by the new vessels in contemplation, the naval architects and the marine engineers have their work cut out for them.

Notes and Comments.

Lloyd Barrage Project.—A brief account of the progress of the Lloyd Barrage scheme is published. After detailing the technical work accomplished so far, the report states that Rs. 575 lakhs was spent on works up to the end of September 1927.

Discussions on Indian States.—At the invitation of H. H. the Maharaja of Bikaner, Lord Sinha has paid a visit to Bikaner to discuss with the Maharaja the Butler Committee and the issues concerning the Indian States which may come up before the Simon Commission. On his return journey Lord Sinha may stop at Delhi to discuss the situation with the Butler Committee and the Simon Commission from the point of view of the Indian Princes.

Herbert Morris, Ltd.—This celebrated Loughborough firm have issued a new and handsome brochure which deals with Morris Hand Overhead Cranes. This is not like the usual compilation of dry facts and tabular matter. On the contrary, it deals in a more or less journalistic way with the transformation that is now taking place in the industrial world, as a result of the realisation of the importance of material-handling as a serious contributor to the balance-sheet.

Eastern Bengal Railway.—The authorities of this Railway, in collaboration with the Industries, Public Health, Veterinary, Co-Operative and Agricultural Departments of the Government of Bengal, have organised a demonstration train, which left Sealdah South Station on the 21st instant on a month's tour. This is the second train of the kind. The object is to give publicity to the activities of the various "nation building" departments of the Government.

More "Sentinels" for India.—The Indian Stores Department of Madras, which has been employing six "Sentinel" patent steam locomotives on the Cauvery-Mettur project for some time past, has just placed a further order with the makers of these engines for twelve more locomotives of the same type as the six already in use. A substantial repeat order, such as this, definitely proves that the first consignment has given satisfaction. Such an obvious truth clearly needs no elaboration.

Institute of Patentees (Incorporated).—This Institute has issued a second edition of the book entitled "What's Wanted." It contains much valuable advice to inventors and patentees. Several articles have been added and other articles of the first edition considerably revised. Over 200 wants have been added. Inventors should apply to the General Secretary of this Institute, whose head office is at 39, Victoria Street, London, S. W. 1, for advice. The price of the book, which is really a very valuable work, is *6d.* or post free *8d.*

Railway Earnings.—Figures of these are welcomed on the eve of the presentation of the Railway Budget in the Central Legislature. From the point of view it will be interesting to learn that the total approximate gross earnings up to the 4th February amounts to a figure which is rupees three hundred and sixty-five lakhs more than for the corresponding period of the previous financial year. The increases are in the East Indian Railway, by rupees eighty-nine lakhs, fifty in the North-Western Railway, forty-seven lakhs in the Burma Railway, forty-two lakhs in the Bengal-Nagpur Railway, thirty lakhs in the Eastern Bengal Railway, and so on, the last in order being the Bombay, Baroda and Central India Railway with an increase of only four lakhs of rupees.

Public Services Commission.—A communiqué issued states that as a result of the competitive examination held by this Commission in November last, the following seven persons have been selected for appointment as probationers in the Transportation (Traffic) and Commercial Departments of the State Railways:—Messrs. S. R. Ram Chandra Iyer, Kailash Behari Mathur, Raghuvansh Lal Gupta, M. Ganapati Iyer, Monindra Nath Chakravarty, Haris Chandra Baral and Saghiruddin Ahmad. Also the following six persons have been selected for appointment as probationers in the Indian Railway Service of Engineers:—Messrs. S. L. Visvanathan, K. S. Narayanan, M. Ganapati, Gopal Yadeo Mangrulker, Malik Abdul Barij and D. L. Chodankar.

Modern Liner Equipment.—In view of the extensive adoption of the gyro compass in the principal navies and the merchant services of the world one might also say that it constitutes an essential part of the equipment of a modern liner. Previous to the inception of the Brown steering gyro compass the relative high price to be paid for gyro steering had debarred many shipowners from deriving its attendant advantages. The steering gyro compass is the adaptation of the standard Brown master compass for direct reading, thereby dispensing with costly repeater mechanism and resulting in extreme simplicity. The four units which comprise the equipment, the gyro compass including binnacle and illuminated projector, motor generator, switchboard, and emergency battery can be easily and conveniently installed on the bridge.

Anglo-Egyptian Relations.—Replying to a question in the House of Commons, Mr. G. Locker-Lampson said that the discussions between the British and Egyptian Governments were still in progress in Cairo. He hoped, however, that they would be concluded in the near future. Recently it was stated that Nahas Pasha, the leader of the predominant party in the Egyptian Parliament, had not been favoured by the Premier, Sarwat Pasha, who had been conducting the discussions on behalf of Egypt in England and Egypt, with any information regarding proposed adjustment of differences relating to Egypt and the Sudan, though it had been announced in certain quarters that most points had been satisfactorily settled. Mr. Locker-Lampson's announcement will be welcome to the Egyptians, who are anxious to learn what proposals are being discussed with reference to such important matters as the military occupation of Cairo and the Nile supplies being used in the Sudan.

Back Bay Harvey-Nariman Case.—According to a Bombay paper, when the judgment of the Third Presidency Magistrate in the Harvey-Nariman defamation case was placed before the Advocate-General for advice as to whether an appeal should be filed, he advised against such a course. The paper understands that, owing to the nature of the judgment, the Advocate-General has advised that the costs of the prosecution should be shared between the Government of Bombay and Mr. Harvey. In view of the waste of

public money the Mears Committee showed to have taken place and the corruption directly responsible proved to have been rampant by the Harvey-Nariman prosecution, it is impossible to avoid the anticipation of some sort of general Government invitation to those gentlemen who have been accused of dirty work being sent to come and clear their reputations or retire from business for a time. They ought not to be missed, as the Back Bay work is said to be progressing satisfactorily and comparatively cheaply since its resumption without their help.

The Port of Bedi.—An authoritative contradiction has been given to the unfounded rumour about its purchase by the Government of India. An Associated Press message, dated the 12th instant, purporting to come from Jamnagar and published in these columns, stated that negotiations were proceeding for the purchase of this port of the State of Nawanagar by the Government of India, and that an offer of Rs. 60 lakhs had been made for it. We regret the mistake into which we were led by an erroneous publication in a contemporary, and we therefore hasten to correct it. It was also stated that an agreement with the Jam Saheb was an almost immediate probability. This was also a mistake for the Press message is in a position to state and contradict authoritatively that this rumour is mischievous and utterly unfounded. There are no negotiations whatever for such a transaction. The sale of the port by the Nawanagar State would be against all precedent and in fact utterly unthinkable. The wonder is that such a false rumour was ever promulgated and given credence to by unsuspecting journals.

Dinajpur-Ruhea Railway.—This is a branch of the Eastern Bengal Railway opened by H. E. the Governor of Bengal on the 15th instant. The opening was a gala occasion and was witnessed by thousands of the population. The Governor of Bengal in his speech said :—This railway will link up the Thakurgaon subdivision with the town of Dinajpur. That subdivision as has been pointed out by the Agent has great agricultural possibilities. At present its surplus paddy, jute, tobacco, sugarcane and potatoes are exported by buffalo and bullock carts. There is every reason to expect that the advent of the railway making both old and new markets easier of access will greatly develop the agricultural area of the subdivision. The alignment has been well chosen, being parallel to the drainage of the country. There is no danger therefore of the construction rendering any area liable to an undue inundation, or affecting health by increasing in any way prevailing malarial conditions. The fact that the construction of 48 miles of railway has been completed in ten months proves the energy and efficiency with which it has been carried out.

The Building of an Accumulator Business.—There is romance in the growth of a big business, and those who recently visited the C. A. V. Works at Acton find it hard to realise the very small beginning of a firm that is now a household word where accumulators in general are concerned. Those who went round the works were impressed by the methodical sequence with which the various parts of the accumulators were assembled, and it was pointed out that the company had benefited from their early efforts. The plates of an accumulator form its most important constituent and those made by Messrs. C. A. Vandervell and Co., Ltd., of Warple Way, Acton, London, W., have certain characteristics which fit them for hard service and long life. The grids are cast in a strong lead alloy containing a definite percentage of antimony and are of special lattice work design. A special construction of positive and negative grids has been adopted to permit of the heaviest discharges without deformation or shedding of the active material. One has to think of the old types of accumulators, seldom free from trouble, to realise to what extent the art of accumulator design and manufacture has developed.

Trade Exhibition in Britain.—A British official wireless, dated the 20th February, states :—The British Industries Fair which opens to-morrow at White City, London, and Castle Bromwich, Birmingham, and continues until 2nd March will be by far the largest trade display ever held in Britain. Two thousand British manufacturers have displayed their best and newest products along 13 miles of stands and their customers, including trade buyers from over 60 countries, are arriving in London and Birmingham by every train. London hotels this week-end are thronged with overseas buyers. One hotel has guests of 17 nationalities. In another there were 50 buyers, a large proportion of whom were Germans. In other hotels are visitors from Australia, Sweden, Holland, Germany, Siam and America. Visitors have come from as far a field as Seychelles. The annual fair is being increasingly used by manufacturers for launching entirely new products on world markets. Sir Philip Cunliffe Lister, President of the Board of Trade, will preside at the Government Banquet to leading exhibitors and buyers at Mansion House to-morrow night with the Duke of York as chief guest. In the afternoon the Duke and Duchess of York will visit White City, while on Thursday the King and Queen will visit the Birmingham section and later probably White City.

British Machinery in Africa.—Nowadays the subject of Britain's export trade is more than ever before the public. The Press of every shade of opinion contains many references to this all-important matter, and often girds at the manufacturer for his apparent tardiness in exploiting distant markets. There are, however, frequently obstacles to opening up new markets which only a close study of local conditions discovers. The transportation of heavy machinery, for instance, not infrequently presents grave difficulties. Thus, on the less developed coasts of Africa, great trouble is experienced in transhipping plant from the ocean-going vessel to the shore. This ticklish work entails the use of surf boats, and includes liberal risk of losing the cargo. Some time ago a steam turbine-generator of 185 h.-p. was sent out by the makers, Greenwood and Batley, Ltd., of Leeds, to the Mocimboa Sisal Development Syndicate for use on one of their estates in Portuguese East Africa. During the process of landing the complete turbine-generator was dropped into the sea. However, it was almost immediately put to work and ran with no ill effects from the immersion, a fact which speaks well for the original quality of the workmanship and material. The plant has given such entire satisfaction during the two years it has been running that a further set of larger capacity is to be installed in the very near future. As fuel in the form of wood and refuse is abundant in the locality, the original set was run non-condensing, exhausting to atmosphere. For the new unit, however, it is proposed to instal a condensing plant, which will appreciably reduce the size of the new boiler and ensure very economical generation of current.

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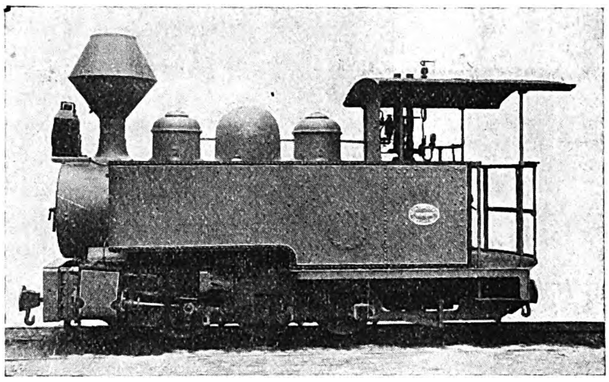

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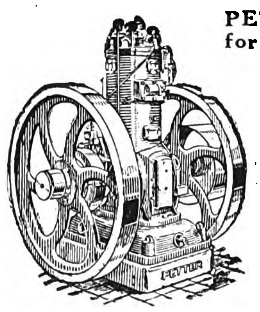

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Mr. A. W. U. Pope, C. I. E.—We regret to hear of the death of Mr. Arthur William Uglow Pope, once a familiar figure on the Oudh and Rohilkhand Railway, at his home in Devizes in England. Mr. Pope's father was Dr. George Uglow Pope of Madras, where he was a missionary and had a reputation as a great Tamil scholar. He had three sons, all of whom did well in their professions. One of them, Mr. John van Someren Pope of the Educational Department was Director of Public Instruction in Burma for seventeen years; another, Lieutenant-Colonel Thomas Henry Pope, was a Professor at the Madras Medical College; and Arthur Pope entered the State Railway service in the traffic branch. He was well known as Traffic Manager of the Oudh and Rohilkhand and as a keen Volunteer, and in both capacities his bright and energetic personality made him conspicuous and gained him many friends. He was an efficient traffic officer and was decorated with the C. I. E. for good work. He closed his service in India as Manager of the Railway on which he had served for a long time, and was afterwards employed in China on the Imperial Chinese Railways, where his services earned him the thanks of the British Government and of the Chinese authorities concerned. Mr. Pope, we feel sure, will still be remembered with affection by many members of the staff of the Oudh and Rohilkhand Railway, in whose welfare he took an active interest.

The Earth and the Moon.—Scientists are sometimes very alarming in their statements until they more fully explain themselves. There was the eminent geologist who informed the engineers of the great Bhandardara Dam of Bombay that the stone of which it was built was not durable, and then afterwards said that its life would be only two million years. That is the way they have of frightening us, and Sir Oliver Lodge, in lecturing the other day on "The Birth of the Moon," said that a time was coming when the Earth would stop spinning and the Moon would crash down upon it and throw it out of commission. But then he proceeded to explain that the time when that would happen was some billions of years hence. The speed at which the Earth rotated was gradually slowing down owing to the friction of the tides, and each day was a 240 millionth part of a second longer than the day before. The Moon is no longer spinning because the Earth had produced tides in it which caused rotation to cease. There was a time when the Earth spun so fast that the day was only four hours long. At that time the Moon was a part of the Earth and then it broke away. But apparently it is coming back again, and coming back with a nasty jar to the Earth. Still, as that is billions of years ahead we need not be nervous at the moment and can rest in our beds at night without sleeplessness and without regarding good Sir Oliver as a bogie-man. *Carpe diem.*

A European Vacation.—Any reader who is planning for a Summer-in-Europe vacation will be interested to read the experience of a New Zealander, who, with his wife, has just completed a tour of England, Scotland and Wales, Belgium, France, Switzerland, Italy, Spain, the Austrian Tyrol and Andorra, which he carried out on trek lines. The tourists landed in England from New Zealand in April, complete with camping equipment. They next searched the motor showrooms for the car best suited to the purpose they had in mind and picked out the 15·9 h.-p. Morris-Oxford—a car which incidentally should be better known. Having made this purchase they proceeded to adapt it for the trek. By laying the front seats with their backs on the floor boards a comfortable bed was provided. A tucker box was attached to one running board and opened out to form a table. The tent which had been brought from New Zealand covered the whole car and provided an extra room, as it were, outside that formed by the car body. Thus equipped the trekkers were able to camp out practically the whole time and to see the countries which were toured under very interesting conditions, avoiding charabancs and conducted tourists, living next to nature and seeing the national life in its real state. For such a trek involving as it does the use of rough byways and tracks the choice of the car is an all-important point. Sturdiness and the ability to negotiate really rough going are essential, as is also reliability of the first order, for one does not want mechanical trouble when one is "miles from anywhere" in the country. It is a tribute, therefore, to the British Morris car, which was chosen on this occasion, that its owners are so pleased with it that they are taking it back with them to New Zealand, convinced that it is just what they need for satisfactory service in their home conditions.

Lake Tsana.—Replying in Parliament to a question regarding the construction of a dam and reservoir at Lake Tsana, in the middle of the country to which the lake is supposed to belong, and referring to the excitement which the intention of the Abyssinian Government to carry out and control the works itself with the help of American capital and engineers, gave rise among British subjects in the Sudan, Mr. Locker-Lampson said:—"The object of the British Government is to get a barrage constructed and worked on sound engineering lines and on conditions satisfactory alike to the Government of Abyssinia and the Governments of the Sudan and Egypt, our primary interest being to secure additional water for the Sudan." Secondary interests, if any, were not clearly specified, thus leaving it open to sceptics, who may have followed the history of the evolution of cotton-growing interests in the Sudan and noted the devices by which (in spite of Egyptian opposition) the Sudan irrigation arrangements are being carried out, to try to understand how the securing of additional water for the Sudan, over and above what has already been forcibly taken from Egypt, is going to be "satisfactory" to the Egyptian Government. They may incline to the opinion that, in spite of sundry promises, it is the cotton-growing interests of the Sudan that concern the British Government, first and last, and Egypt is being let down badly. They may think that, if there were good prospects of securing, through the British helpers operating on the head-waters of the Blue Nile more water than the Sudan can be satiated with, Egypt may stand a chance of getting back some of the supplies she has already been deprived of. But they may be unable to see how this is to be managed, even if both normal and additional lake storage can be drawn on and fully replenished from the small drainage area supplying the basin. Unless this is made clear they will hold that there is insufficient evidence to show that the "sound engineering lines and satisfactory conditions" asked for are not just a demand for abdication by Abyssinia of her rights in the valley of the Blue Nile, a privilege she is reluctant to relinquish, and that the loss to Abyssinia will be no gain to Egypt in the end.

Current News.

OFFICIAL advices from Uganda estimate the cotton crop of the Protectorate for the year 1927-28 at from 110,000 to 140,000 bales.

THE United States Steel Corporation has decided to establish itself in Canada and build big factories for the Canadian market and export.

MR. A. L. RHIND, Works Manager, Carriage Shop, B.-N. Railway, proceeded on nine months' combined leave from 7th February.

THE total world consumption of electric lamps is of the order of 600 millions. Of this amount about one-twentieth is used in Great Britain.

IT is stated that by changing the terminus of the Hudson Bay Railway from Port Nelson to Fort Churchill, a saving of 17,700,000 dollars can be effected.

THE Chief Electrical Engineer and the Colliery Superintendent, East Indian Railway, have been gazetted heads of their respective departments.

A MEETING of the Sanitary Sub-committee of Indore held on 11th February passed a resolution that the river passing through the city should be drained off at once.

THE Canadian Post Office Department has, it is understood, formulated plans for the construction of a new postal terminal at Montreal which will cost about 2,000,000 dollars.

THE Council of the Institution of Electrical Engineers have made the seventh award of the Faraday Medal to Professor J. A. Fleming, F. R. S., honorary member of the Institution.

THE headquarters of the T/S (South Portal) Subdivision of the Adit Division, Punjab. P. W. D., Hydro-Electric Branch, were transferred from Joginder Nagar to Wayer on 4th October 1927.

ABOUT 400 citizens of Rangoon were given an opportunity on 15th February of viewing the progress of the King's Bank Reclamation Works when the Governor inspected them, as well as the Port.

A RANGOON message says that the strike at the Irrawaddy Flotilla Company's Dockyard at Dalla has terminated, the rest of the strikers having returned to work, as far as is known, unconditionally.

A CONTRACT has been arranged for the supply of 52 million units of electric energy, from the Grampian Electricity Supply Company, for distribution by the Central Electricity Board to the South of Perth.

THE 700 men of the Calcutta Port Commissioners' shunting and gate staff who went on strike on 30th January resumed work unconditionally on 16th February and normal working conditions prevailed from the following day.

COMMENCING on 1st February the Simplon-Orient Express will provide a passenger service from Paris to Cairo. The section between Tripoli and Haifa will be covered by motor-car, pending the completion of the railway.

THE first of the locomotives ordered by the Turkish Government from Aktiebolaget Nydqvist och Holm at Trollhaottan has been completed. The total order, it is understood, is for over 150 locomotives, and about 1,000 trucks and carriages.

MR. M. N. PEARCE, Agent of the E. B. Railway, President-elect of the Indian Railway Conference Association for 1928-29, has assumed office owing to Sir Ashley Biggs having left India on medical grounds before the expiry of his term of office.

IT is reported from Belgrade that the Cabinet has approved a scheme for the building of a railway from Belgrade to the Adriatic, and port development at Booche di Cattaro. The new line will pass through Kragujevatz, Kossovo, and Podgeritza.

CONSEQUENT on the transfer of the Quarries Division, P. W. D. Punjab, Buildings and Roads Branch, from the Fourth to the First Circle of Superintendence, the headquarters of the Division were transferred from Lahore to Jhelum on 16th January 1928.

THE capital cost of the proposed new works on various Victorian outer ports will be :—Gippsland Lakes, £250,000; Welshpool, £80,000; Warrnambool, £300,000; Port Fairy, £100,000; Portland (immediately), £10,000; total, £740,000.

THE first electrically operated section of the Transandine Railway, from Rio Blanco in Chile to Las Cuevas, on Argentine territory, was officially opened at the end of November last. The innovation will not only speed up the service, but the absence of smoke will render the journey through the tunnel less unpleasant.

MORE than 2,500 men are employed in the Federated Malay States Railway workshops for the maintenance and repair of locomotives, carriages, wagons, and plant. The railway is 1,005 miles long on the metre gauge, and the plant comprises 227 locomotives, 5,700 passengers and freight vehicles, and 12 steamships.

ACCORDING to the announcement of the representative of the British Syndicate headed by Lord Gainford and Sir George Courthope, which plans large investments in the industrial development of the Province of Quebec, one of the first steps will be the construction of 32 miles of railway into the copper-mining field in the Lake St. John district.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

THE HIGH COST OF ROADS.

SIR,—I am glad that we small men have found a champion in "Σ. φ." We hope he will help us by persisting in his attacks and make the manufacturer class more sensible. We do not get unlimited funds to keep roads to the standard of efficiency the manufacturers clamour for. The general public do not make a row unless they happen to be the unfortunate purchasers of the manufacturers' products.

DISTRICT ENGINEER.

13th February 1928.

A CORRECTION.

SIR,—In the last issue of your articles on Indian Engineers you say that I prepared *the* Project for the drainage of Cairo for the Water Company. I prepared *a* Project for the drainage of the sewage alone as the roads were too bad to allow storm water to enter. Later the roads were greatly improved and Mr. Carkeet James prepared *the* combined Project. I may add that it was with deep regret that I had to report to Lord Milner that irrigation projects of the class he contemplated were impossible in South Africa owing to the formation of the country; and I also had to report unfavourably on the Roumanian projects as the irrigation of the higher steps would have ruined the lower steps.

W. WILLCOCKS.

IS RESEARCH MYSTERIOUS ?

SIR,—Mr. W. S. James, research engineer, of the Studebaker Corporation, in the "Journal of the Society of Automotive Engineers" writes :—During somewhat more than fifteen years' contact with both pure and commercial research work I have observed a general belief that research is something mysterious and uncanny. This belief has been fostered rather than corrected by the popular magazine and newspaper versions of scientific research. At present I feel that the word "research" is losing its true meaning, and research endeavour, valuable as it is, may suffer from the misunderstanding. It should be easy to see why anyone working in research should have a well developed, natural and honest curiosity, and should be able to tap unusual sources of information and to perform experiments to check suggested solutions. Problems which require immediate solution are common in any industry to-day. The quickest solution of such problems are obtained when they are attacked by someone with an honest enquiring mind who has access to all available information. When essential information is lacking it is impossible to check experimentally with ideal accuracy, but a more nearly correct answer can be obtained with commonsense and attention to facts previously established. In the automotive industry it has often been said that no time is available for the solution of any but immediate problems. It also seems that few men in the industry are considering seriously what problems will confront them one year or five years ahead. At our present stage of industrial development very few facilities have been co-ordinated with industrial activity for carrying out work of this nature. University laboratories and similar institutions are the most promising sources for the solution of such problems, but their contact with industry is usually limited, and their knowledge of future problems of industry is, therefore, lamentably weak. Were it possible to arrange a scheme of co-operation between industry and such institutions for working out problems of general or potential industrial interest, a two-fold benefit would result, as industry would be provided with information at an opportune time, and the men leaving the universities would have a clearer understanding of the problems of industry through the closer contact of their professors with industrial problems. One of the possible by-products of such a relationship would be the retention in this particular line of endeavour of the men who are best fitted for it. Some men show marked aptitude for research work. Such of these men as are outstanding should be so fitted into our economic structure as to utilise their abilities to the maximum. If they could work with commercial objectives in the university atmosphere much good would result. The above words are wise advice and should be taken seriously.

X.

Foreign Notes.

Tyneside Survey.—According to the "Builder" a valuable survey of a group of towns on the Tyneside, including four county boroughs, two municipal boroughs and seven urban district councils, has just been completed. This was not a regional survey but was an effort to discover how the Tyneside, as it is in the years 1926—28, has been shaped and how it appears to be shaping. Few strangers to the district who pass down the north bank from Newcastle to the sea, realise that they are passing through Gosforth, Wallsend, Tynemouth, Whitley Bay and Monkseaton; or, if they cross the ferry and return to Newcastle, that the one huge town through which they are passing, is, in fact, South Shields, Jarrow, Hepburn, Felling and Gateshead. One point of special interest to housing reformers and architects is raised in the report. It is stated that housing is one of the matters in which the Tyneside differs very much from most industrial areas in England and Wales, for there is an old and persistent tradition of small and congested homes. Two and three-roomed houses akin to those in Scotland are the predominant types. The report states that fortunately the coming of the subsidy house, designed by architects, is creating a new and better tradition.

Second International Conference on Bituminous Coal.—The Carnegie Institute of Technology now announces that the second International Conference on bituminous coal is to be held at Pittsburgh on 19th to 24th November. The purpose of the Conference is similar to the one held in 1926 by the Carnegie Institute, namely, to present the results of recent studies of coal that have to do with improved methods of utilisation and combustion. The programme will include the discussion of the fixation of nitrogen, the manufacture of substitutes for petrol from coal, complete gasification of coal, high-temperature distillation, low-temperature distillation, coal-tar products, power, smokeless fuel, etc. An invitation is extended to scientists of all countries to take part in this Conference. The president of the Carnegie Institute, Mr. Thomas S. Baker, will visit some of the principal cities of Europe during the months of March and April 1928 to confer with fuel technologists who may consider the possibility of presenting papers or taking part in the Conference in any other way. Mr. Baker's address after 25th February will be care of the Guaranty Trust Company, 1, Rue des Italiens, Paris, where he will be glad to receive correspondence in regard to the Conference. A more detailed statement will be issued later.

Central Heating from Electricity Works.—In the "Génie Civil" for 7th January an account is given of the public supply of steam for heating at Utrecht, Holland, a city of 130,000 inhabitants. It is pointed out that as old power stations situated in populous districts are superseded by large external stations, the former are sometimes retained to serve as stand-by plant and to help during peak loads, and it is desirable to increase their "co-efficient of utilisation" as much as possible. The old station at Utrecht is close to several hospitals, the University laboratories, office buildings and the central railway station, so that the conditions for the sale of heat are favourable. Saturated steam is produced by three boilers at 150 lb. per square inch, and by a water-tube boiler at 220 lb. per square inch, superheated to 350° C.; the latter is led into a cooler where cold water is injected into the steam, reducing its pressure and temperature. From a drum receiver the steam is distributed through underground pipes in concrete ducts to the consumers. The central hospital and the railway offices are heated by hot water, which is heated by the steam in counter-flow apparatus. The output in 1926 was at the rate of 55 million kg. of steam per annum, the sale price being 11*d*. per unit of 100,000 calories, with coal at 20*s*. per ton.

Exhibition of Scientific Apparatus.—A new type of bomb calorimeter and a surface-heat-loss meter were amongst many items of interest at an exhibition of instruments and scientific apparatus held by the Junior Institution of Engineers on 6th January. The Scholes bomb calorimeter is made of stainless steel in two portions, a body and a base, which are screwed together lightly by hand, thus avoiding all necessity for the use of force in sealing the interior. The Foster surface-heat-loss meter is a piece of apparatus which is being perfected for the estimation of heat-loss from boiler settings and for similar purposes, giving a direct measurement of a factor which is at present largely a matter of deduction. Other instruments exhibited were the Brown gyroscopic compass, repeater and automatic course recorder, and also the Brown electro-megaphone; an analytic quartz lamp with special glass colour filter for analysing the fluorescent properties of substances and for the detection and determination of chemicals in solution; also a Homesun quartz lamp for home ultraviolet-ray treatment. Amongst an interesting collection of micrometer gauges there were the Prestwich fluid gauge and also the Krupp microtasimeter giving an easy optical reading with great accuracy. An electric furnace was shown in operation, and apparatus for the determination of copper in non-ferrous alloys by electro-analysis was displayed.

Arc-Welding Rail-Joints.—Oxy-acetylene welding of worn rail-joints in position has been widely practised for some time in America, but latterly electric arc-welding is being used on railways in the Western States with good results. The complete outfit travels on the rails and has transverse wheels for removing it to the side of the track on a small platform built of sleepers at the site of operations. The main welding unit consists of a 40 h.-p. four-cylinder engine directly connected through a clutch to a 250-ampere welding generator with a specially-designed grinding generator and exciter directly connected to the extended shaft of the welding generator by flexible couplings. Since July 1924 the welding company has restored nearly 150,000 joints; all the joints were ground to the true section of the rail and left in as good condition as when new. The advantages claimed for the welding process are that the welding heat is localised, and there is no softening of the rail-ends; long defects may be corrected as the heat is confined to the extreme upper surface of the rail, there is no chipping or spalling of the added metal; the full section of the rail is restored for the length of the angle fishplate by surface grinding; compression fractures are prevented by cross-grinding the end of the joint; the flow of metal at the ends of the rail is reduced to a minimum, and the cost per unit of area welded is less than heretofore. The process also has been used successfully in the building-up of manganese crossings.

Ventilation of Battery Rooms.—At the London Branch of the Institution of Electrical Engineers, on 5th January Mr. E. C. McKinnon read a paper on "Storage Batteries in Relation to Modern Supply of Electric Lighting and Power," in the course of which he touched upon battery-room design and pointed out the necessity of effective ventilation of such rooms in order (1) to keep the battery surroundings dry and so maintain high insulation; (2) to regulate the temperature of the room; (3) to disperse any gases evolved during charging. The gases are oxygen and hydrogen given off in explosive proportion, *i. e.*, one-third oxygen and two-thirds hydrogen. The amount is greatest when a healthy battery is being overcharged. The gas evolved is a direct result of electrolysis of the water in the electrolyte. If the plates are not absorbing any of the charge, the whole of the electrical energy passed into the battery will be expended in electrolysis. For every 1,000 ampere-hours per cell so spent, the amount of gas evolved will be 22 cubic feet in the proportion of one-third oxygen to two-thirds hydrogen. This represents 0·74 lb. of water, a loss quite distinct from that due to normal evaporation. Doubtless because battery-rooms as a rule are lofty and spacious, no serious explosion of a stationary battery has yet been recorded. Such small explosions as have occurred have usually been traced to carelessness, such as smoking in the battery-room or accidentally short-circuiting the battery during charging.

The New Omdurman Bridge.—According to "The Engineer" on 16th January Sir John Maffey, the Governor-General of the Sudan, opened the new bridge over the White Nile between Khartoum and Omdurman. The bridge will provide for both vehicular and passenger traffic, and will carry a new electric tramway on a road 30 feet wide. When the volume of traffic demands it, two additional footways, each 11 feet wide, will be constructed, and will be carried on outside brackets attached to the main trusses. There are seven 244 feet spans, and a single swinging span, 304 feet in length, which is electrically operated and will allow vessels to pass the bridge. The new bridge was built under a concession granted in 1925 to the Sudan Light and Power Co., Ltd., to develop the public utility services in Khartoum and Omdurman, which project includes water, lighting and power and transport undertakings. The companies concerned in the contract were Dorman, Long and Co., Ltd., the English Electric Co., Ltd., Callendar's Cable and Construction Co., Ltd., and the Prudential Insurance Co., Ltd. The two first-named firms were represented at the opening ceremony by Sir Hugh Bell, deputy chairman of Dorman, Long and Co., Ltd., and Mr. P. J. Pybus, chairman of the English Electric Co., Ltd. Work on the bridge was begun in the autumn of 1925, and it was finished five and a-half months ahead of the contract time, in spite of the delay caused by the general strike and the coal stoppage. The cost of the undertaking was close upon £800,000.

Further Diesel Locomotive Tests in Russia.—According to the "Railway Gazette" during the year 1926 and earlier Diesel-geared and Diesel-electric locomotives were built on the Continent for service on Russian railways. These engines have been submitted to comparative tests, culminating in a long-distance run between Moscow and Baku in the Caucasus, a distance of about 3,000 miles. The two trains, one hauled by a locomotive with gears, and the other by one with electric transmission, followed each other from two to eight hours apart, the coupling in and out of the dynamometer car causing considerable delay. Several side trips were made with the engines in order to test them on heavy grades. The test report shows that the locomotive with electric transmission made a total of 3,306 thousand gross ton-miles and consumed 43,150 lb. of oil, or 13·05 lb. of oil per 1,000 gross ton-miles. The other locomotive, with magnetic gear transmission, made with trains of approximately the same tonnage and speed over the same distance and under virtually the same weather conditions, 3,455 thousand gross ton-miles, and consumed 40,780 lb. of oil, or an average of 11·81 lb. of oil per 1,000 gross ton-miles. This represents a saving of 9·5 per cent. in favour of the Diesel locomotive with gear transmission, and is in conformity with the figures for efficiency obtained from the stationary tests made with the same locomotives. It is further stated that oil-burning steam locomotives in Russia, hauling similar trains, consume 80 lb. of oil per 1,000 gross ton-miles, or from six to seven times as much as the Diesel-engined locomotives.

Roller Bearings.—In a paper recently presented to the American Society of Mechanical Engineers, Mr. W. C. Sanders discusses the design and application of roller bearings to railway rolling-stock, says the "Railway Gazette." He points out that the severe conditions which such bearings have to meet in railway service make their successful design difficult, and that many attempts had been made to solve the problem of anti-friction journal bearings on railways. Failures had ordinarily resulted from one or more of three causes:—(1) Crushing strains under heavy loads and blows upon the surfaces of the metals in rotating members and raceways, resulting in fatigue and fractures; (2) diagonal twisting and jamming of rollers; and (3) the troublesome end thrust which may at times equal 40 per cent. of the vertical load. After considerable experimenting, the company with which the author was connected had produced a tapered roller bearing which was practically frictionless, and which had proved successful in railway service. The paper describes the Timken tapered roller bearing which is in use on the Chicago, Milwaukee and St. Paul Railway. It consists of four main parts, the double cone or inner raceway, two sets of tapered rolls, two cages, and two cups or outer races. The cone, common to both sets of rolls, is formed with ribs at both outer ends, and is tapered to a ribbed apex in the centre. The two sets of rolls are assembled on the cone and held to proper spacing by their respective cages. The two cups are then assembled over the rolls. The bearing is assembled in the housing and then pressed on the axle, after which the adjustment is made by shims. Practical tests had demonstrated the superior economy and efficiency of these bearings over plain bearings, their durability, low cost of maintenance, elimination of friction and hot boxes, reduction of wear to the rolling-stock, and the greater speed and power gained by their use.

General Articles.

GREAT ADVANCE IN PULVERISED FUEL FIRING.

AN important advance in pulverised fuel firing has been achieved by the Research staff of International Combustion Ltd., London, in the shape of a burner representing many months' investigation and continuous large scale operation, carried out mainly at Barrow. This new burner is known as the "R" type, and will now substitute the well-known "Lopulco fish tail" design being claimed to be a revolution in pulverised fuel firing. The main point is that with an enormous throughput, up to 150,000,000 B. Th. U. 6 tons of coal, per single burner per hour, the flame is complete in 10 feet only instead of 30 feet. This of course means an enormous reduction in the size and cost of the combustion chamber for water tube boilers, giving a setting now very little higher than for modern mechanical stoking, and it opens up an entirely new field with regard to the use of pulverised fuel in furnace work generally, for cylindrical boilers of the "Lancashire" and "Scotch" marine type, glass works, pottery and general ceramic kilns and many obvious applications in the iron and steel and general metallurgical industries.

We are able to give an illustration of the new "R" burner on the opposite page which is of the "turbulent" type but on new and improved principles, the pulverised coal, mixed with 15 per cent. of the total air for combustion, that is, the primary air, enters at the top of the burner and passes through it by means of a circular concentric casing or burner "head," which in the centre has a lighting and inspection tube. The mixture of air and pulverised coal is given a violent turbulent motion by means of aeries of internal spiral projections or ribs, and for this portion there are no adjustments necessary of any kind. The secondary air, 85 per cent. of the total, enters by another concentric casing, nearer the furnace, behind the first casing, and is also given a violent turbulent motion, while the only adjustment necessary in the whole of the burner is one damper or slide on the secondary air supply. As already stated the mixing of the fuel particles and the air is of such an efficient and intimate character that the combustion is complete, with 17-19 per cent. CO_2 and no unburnt gas, in a flame of 10 feet only.

The whole question of burner design, whether for solid, liquid, or gaseous fuel, is of far greater complexity than is commonly imagined. To express the matter in a few words the ideal burner, especially for pulverised fuel firing, must always deliver at the flame point an absolutely uniform mixture of coal and air without any "stratification," that is tendency to separation of the solid particles, while a simple design is essential, capable of immediate and final adjustment, and not influenced by the external piping arrangements through which the air and coal are supplied. Further it must operate under low air pressure conditions, especially because of efficient power consumption, be easily applicable to any type of furnace, and not be affected by the great heat from the chamber, while also it has to be able to take a large amount of coal.

Almost any one can design a "Turbulent" burner that necessitates a very high air pressure to obtain the mixing effect—requiring an impossible power consumption—and has to have a number of complicated parts with almost constant hand adjustment to try and give a reasonable efficiency at all kinds of different load conditions. In practice, however, for actual continuous large scale operation burners of this type are well-known to be a hopeless proposition because of the cost of the power, air leakage, the necessity of constant highly skilled attention, and breakdown due to the heat from the combustion chamber. It is claimed, however, that the "R" burner, after extensive investigations has solved the problems, while the final design has been operating continuously for months at Barrow, and is to be fitted immediately on a number of important plants including Hams Hall, Birmingham, for example.

As already stated a single burner will take up to 150,000,000, B.Th. U. per hour, while the static pressure for the primary air 15 per cent. of the total air used to transport the pulverised coal is only about 2 inches W.G. and the secondary air admitted in a concentric conduit, being 85 per cent. of the total volume, is only 1 inch W. G. The problem of stratification has been eliminated entirely, and in fact that coal is separated from the air in the burner itself by cyclonic action and then re-mixed with the secondary air, so that any stratification in the supply pipe circuits is of no importance. The simplicity is such that, as indicated, the only adjustment necessary is a small sliding damper on the secondary air pipe so that in obtaining the most efficient results with the burner the skill of the operator hardly comes into the matter at all.

Naturally also the fact that enormous individual burners can now be constructed to work at high efficiency means that in say the largest power station unit with 10-12 burners, only three or four of the new burners will be necessary, giving further advantages in the way of simplicity of roof construction of the combustion chambers, while also the burner is effectively lagged against heat from the combustion chamber apart from the simple and robust construction not easily affected in any case because of the small number of individual parts each easily replaced. Finally, also gaseous or liquid fuels may be used without difficulty instead of pulverised solid material.

FACTORIZATION.

III.

THE factor f seems to vary very slowly in semi-elliptical sections, which is the chief advantage of such sections, because it admits of easier control of V_0, small mistakes being not so important as with other sections.

TABLE F.

REF. No.	Pyr. Section.		Burma f	Pyr. f_p	Ellipse f^{II}
	x	f			
3113	276·1	2·931	2·949	2·927	Uniformly 2·121
3114	275·4	2·930	2·971	2·927	
3115	277·6	2·931	2·992	2·927	
3116	283·6	2·932	*3·012*	2·929	
3117	297·0	2·935	*3·031*	2·932	
3118	295·1	2·935	*3·049*	2·932	
3119	285·1	2·932	*3·067*	2·929	
3120	275·8	2·930	*3·084*	2·927	

The above table shows the exact f of the Pyramid unit-section ABCD, see article I and Fig. 1, and represents the newly-dug canal with 5 : 3 side-slopes. The Burma f shows what would happen if this Pyramid Section were subjected to $V_0{}^1$ as calculated by the Kennedy derived formula, $0{\cdot}95d^{\cdot 57}$, and it is clear at once that every section would be enlarged by scour, at any rate, at these great values of d. The Pyramid f_p is-

the mathematical artifice of the "Factorized Hydraulic Formulæ" articles. The comparison is as below :—

(*i*) Pyr. Section $f = \frac{3(x + 5)}{x + 11.662}$

(*ii*) $f_p = \frac{3(x + 5)}{x + 12}$.

The values obtained for f_p are just a little within the actual f of the sections, so that the artifice cleverly reduces calculation while securing the minimum of scour.

The ellipse f^{11} avoids all scour and silts the newly-dug channels with the appropriate V_o^{11} to semi-elliptical (or closely so) outlines, each semi-ellipse being inscribed within a Pyramid Section (see Fig. 1.). The reader will note that, in preparing the above table x = W − 10, while W is assumed to be the major diameter of the ellipse (Table E.). This has not been done inadvertently or by error. By equation (ii), f_p has the values given in Table F. The writer concludes that the Pyramid practice was to dig the canal somewhat larger than designed, saving the expense of trimming banks and levelling bed across with excessive accuracy, and trusting alone to V_o^{11} to silt the roughly excavated and unfinished canal to the semi-ellipse. With the forced and unwilling, and unskilled, labour of that period, no doubt this was found to be the most economical and certain method of obtaining accurate and permanent results. All that was needed was intelligent supervision in letting water into the newly-dug channel; and equally, no doubt, strict attention was paid to this, with picked skilled labour. There can be, at least, no doubt whatever, that the ancient engineers made use of V_o as an engineering tool. The dimensions of the semi-ellipse depend wholly on V_o^{11}, f^{11}, and y, and the skill and judgment exercised in obtaining the exact V_o^{11}.

One point of real importance (see article II) needs to be mentioned again. The writer is quite certain in his own mind that in a CONSISTENT SERIES of V_o or of V_o^{11}, the length of inclination l_p to unity is a constant. But, if this is found to be an error, it would make no difference to any other argument or conclusion. The essential factor in the problem is V_o or V_o^{11}; and the canal engineer knows very well how to secure this. Only, *he must be absolutely certain that he has got it, correct to the third place of decimals*. It is no good being right to 2½ per cent., or even one per cent. It is very likely the ancient engineers trusted wholly to experience, keen eyesight, and what may be called the hydraulic instinct. The more fortunate modern engineer can acquire or inherit all these qualities, and employ the most delicate modern instruments of precision as well.

These three articles are preliminary to a full consideration of the PYRAMID KENNEDY FORMULA, and have been written after a complete draft of the above has been prepared. The writer is convinced that Kennedy's work, so far as it went, was absolutely sound and reliable, while the derived formulæ in use elsewhere are not. The writer hopes to be pardoned, in the interests of exact science, for making this bald assertion, and he has no desire to offend. Kennedy's Formula is correct only in the conditions in which he devised it. In other conditions it may be actually dangerous.

The "Kennedy" Formulæ in use appear to be :—

Kennedy Original	$0.84d^{.64}$
Sind	$0.63d^{.64}$
California	$0.98d^{.64}$
Madras	$0.67d^{.55}$
Burma	$0.95d^{.57}$
Rio Negro	$1.01d^{.44}$
Egypt (*metric*)	$0.283d^{.727}$

The Panjab engineers also use modifications of Kennedy's original formula, by altering the constant 0.84, in the same manner as do Sind and California.

By working out these formulæ for a considerable range of d, it is found that in ordinary sections of canals, they all may offer reasonably good V_o, but that, as soon as the sections depart from the normal standards, they all give impossible V_o, mainly scouring velocities in the larger sections, see Table F, or unduly silting velocities in the smaller channels. In other cases, the V_o would do the contrary: silt the larger and scour the smaller. Factorization, and comparing f, shows this very plainly and remarkably. And the really serious consideration in the case is, that any ordinary engineer relying wholly on the formulæ, may do infinite mischief without being aware of it until it is too late. The formulæ can be safely employed by thoroughly trained and experienced staffs, but no others.

It amounts to this: the velocity of flow in any artificial earthen channel is a most effective engineering tool, constantly and persistently at work, day and night; and in inexpert hands it is a most terrible instrument of evil.

If now, $V_o = C_o \sqrt{m_p}$, then the tentative value which might be assigned to C_o are :—

Kennedy's original sections ...	C_o = 1.201
Sind	„ = 0.8998
California	„ = 1.400
Madras	„ = 0.8064
Burma	„ = 1.234
Rio Negro	„ = 0.9861
Egypt (foot measure) ...	„ = 0.6596

When C_o = 1.000, $V_o = \sqrt{m_p}$.

Σ. Φ.

31st December 1927.

ELECTRICALLY-DRIVEN ROLLING MILLS.

THE application of electric power has made considerable progress in the steel industry during recent years, and numerous steel works have converted not only auxiliary plant, but also the rolling mills to electric driving.

The use of electric motors for driving rolling mills is now generally recognised as the cheapest solution of the problem of obtaining flexible control of large power outputs at variable speeds, to suit the arduous service conditions of the mill.

An interesting example of the modernisation of power equipment in this industry is represented by the installation of electrical plant and switchgear recently carried out at the Alliance Forge and Rolling Mills, of Messrs. C. Meadows and Co., Ltd., at Attercliffe, Sheffield. The contract was entrusted to the General Electric Co., Ltd., Magnet House, Kingsway, London, W. C. 2, and the plant was manufactured at the Company's Witton Engineering Works, Birmingham.

The plant in these mills was formerly driven by steam power, and the steam drive has been replaced by electric motors due to their facility of control and greater flexibility in power transmission. Other reasons for the change may be mentioned such as the economy of space due to steam engines, boilers, and coal storage being entirely eliminated. The cost of labour which is always an important item, has been reduced owing to the electrical equipment requiring less attention than the steam plant; the latter in addition required a certain amount of labour before operations commenced, and had to be shut down when the works was closed.

The plant in this steel works consists of 14-inch and 10-inch rolling mills, two 42-inch hot saws 4-inch by 1 inch cold shears, and a 1⅛-inch to 4½-inch reeling machine, the electric power for the driving motors being supplied by the Sheffield Corporation, and controlled by switchgear accommodated in a room at the steel works.

The supply is 350 volts, 3 phase, 50 cycles, and this is connected to a steel plate switchboard consisting of five cubicles, all the doors of which are arranged for front access. This arrangement enables the switchboard to be mounted flush with the wall, thus conserving floor space. These cubicles are equipped with oil circuit breakers having over-current and under-voltage releases to prevent the motors being overloaded to a dangerous extent, and to rupture the circuit should an abnormal drop in the voltage occur. One of these circuit breakers controls the incoming supply, while the others are connected to the feeder circuits of the larger motors. An ammeter registers the current absorbed by each circuit. The larger motors are started from the switchgear room by means of liquid starters. This method of starting enables the motors to run up to speed very evenly, the resistance being regulated in a gradual manner. The smaller motors have separate control units mounted in close proximity.

The motors are of the well-known G. E. C. "Witton" slip-ring type, the largest having an output of 500 h.-p. at 420 r. p. m. and driving the 14-inch rolling mill.

This motor is mounted below the floor level of the mill and drives the mill shafts by means of ropes. The rope wheel attached to the mill shafts also acts as a fly-wheel, and in the case of the 14-inch mill weighs 24 tons.

The reasons for installing the motor in this position may be summarised as follows :—

(1) Economy of floor space.
(2) Facility of changing over from steam to electric drive.
(3) Protection from dust and damp.

In connection with the above it may be mentioned that the floor extends over the mill motor and is utilised for manufacturing purposes. This floor also provides protection for the motor.

The above remarks also apply to the 300 h.-p. motor running at 420 r. p. m. and driving the 10-inch rolling mill. This machine is mounted adjacent to the 500 h.-p. motor, and drives the mill by means of ropes in a similar manner to that already described.

These mills are electrified throughout and some of the auxiliary processes are described below. The two 42-inch hot saws mentioned above cut the bars to the required sizes immediately they have left the rolls. Each of these saws is driven by a 40 h.-p. motor running at 715 r. p. m. mounted on the top of the machine. The motors are started and controlled by a unit mounted on the side of the machine at a suitable height for operation. This unit consists of a G. E. C. "Salford" iron-clad disconnecting switch and fuses, and a faceplate rotor starter with air-cooled resistance.

Another auxiliary machine is the 4-inch by 1-inch cold shears which receives strip iron direct from the rolls and cuts it into required lengths. This shears is driven by a 15 h.-p. motor running at 708 r. p. m. controlled by a unit mounted in close proximity.

The reeling machine performs the final operation of polishing the bars before despatch, and is driven through gearing by a 100 h.-p. "Witton" motor designed by a speed of 725 r. p. m.

Electric motors occupying little space can be mounted in convenient positions for coupling to the steelworks plant. Individual machines are installed for each section of the plant, dispensing with the use of heavy belts and shafting, thus enabling many economies to be effected. These are very great advantages when the layout of a new works is under consideration or the electric drive is being introduced.

STAR CARS FOR THE KING OF ARABIA'S HAREM.

A MIXED fleet of exceedingly beautiful and speedy Star Cars providing for the accommodation of over a hundred members and attendants of the Arabian Court, and costing over £10,000, was recently in London awaiting shipment to the Holy City of Mecca. Capable of a speed of from 55 to 65 miles per hour, and finished in brilliant aluminium and white, this assemblage of box harem cars, open 24-seater coaches for royal guards and 7-seater touring models offered a spectacular appearance fully in accord with the Eastern tendency towards lavish display. The vast numbers of Moslem pilgrims arriving yearly at the Tomb of Mahomet will thus find the ancient seat of the faith invaded by the latest examples of Western progress in the science of road transportation.

Four of these cars, 7-seater 20-60 h.-p. Star touring models, are for H. M. Ibn-Saud, the King of Arabia, and his personal suite, and a ride in one of these 6-cylindered cars will probably correspond to our O. B. E. as a reward of merit. Two open coaches mounted on Star 6-cylinder low-loader commercial chassis and capable of extremely high speed will accommodate the armed guard of some fifty warriors, and a harem of 24 ladies will find itself in two-blinded, box-bodied vehicles which promise a certain warmth in what is certainly the hottest climate in the world. The ladies will sit upon their crossed feet facing each other along the sides of the interior with pile carpet below, upholstery at back and arm-rests to support their pretty elbows. Six a side. One can imagine their charming rose-wreathed heads nodding in unison amidst a babble of conversation as the vehicle pitches gently on the rough desert surface at speed. There is certain to be conversation, for the ladies will be entirely unable to look out, and will therefore suffer from a considerable unsatisfied curiosity. An electric fan will do its best to give cool comfort, and a 20-gallon tank of water will be on tap. But the aluminium exterior will probably be too hot to touch, and a somewhat overheated harem may possibly result.

The appearance of the fleet, whether moving softly between the mosques of the Sacred City or streaking in glancing brilliance across the burning desert, will undoubtedly do much to increase the prestige of the Arabian monarch among the fierce tribes under his rule. The Flying Carpet of the Arabian Nights was a charming dream, but the "Star Flyers" of modern Arabian days are an excellent reality. The material advantage is all with the present.

The circumstances of the original order for these cars has in itself an element of romance, for Mr. Stuart D. Marr, of Messrs. Arthur Stuart and Co., of London, a Star Car agent, served in Arabia under Colonel Lawrence, and was honoured by the friendship of His Majesty. When the question of purchase was mooted, the King, who had a leaning towards the Star make on account of the excellent record of an ancient vehicle working in the locality approached Mr. Marr on the subject, and after a tour of the Arabian emissaries around various motor works, a choice of the Wolverhampton product was decided upon.

The actual specification of the models is as follows :—

Touring Cars.—Four 20-60 h.-p. 6-cylinder, o.h.v. 7-seater Star touring cars, standard 1928 models, capable of 60-65 m. p. h. Ordinary accommodation, but fitted with two extra tip-up seats. Polished aluminium panels, buff leather upholstery, single windscreen. Curtains and hood in khaki twill, hood double-lined. Twenty-gallon water tank under near side-running board, one 20-gallon petrol tank at rear and another on dash. Electric lighting with extra paraffin lamps. Extra large radiator, 34 by 7 straight-side Dunlop tyres as usually used on commercial vehicles, and wire wheels, spare wheel each side. Tool boxes on running boards each side.

Lucas Hydraulic Jack, extra strong luggage carrier, usual springing with extra leaves and Gabriel Snubbers. Extra strong differential. Hair carpets. Steel flagstaff on off front wing. 11½ inches ground clearance.

Open Coaches.—Two 24-seater open charabanc, bodies in polished aluminium, with seats in pairs, mounted on Star Flyer 6-cylinder low-loader chassis capable of 55 m. p. h. Permanent heads, khaki covered, with airspace and khaki lining. No side-curtains. Accommodation rail for lackeys on running boards. Forty-gallon petrol tank under one running board and 20-gallon water tank at other side. Two spare wheels and tyres carried at rear. Other details as touring cars.

Harem Cars.—Two box bodies, 10 feet by 6, in polished, lined aluminium, with double doors at rear and folding steps, m unted on Star Flyer 6-cylinder low-loader chassis. Interior painted white and upholstered with buff leather-covered squabs to a height of 3 feet. Six upholstered arm-rests to each side, giving accommodation to twelve ladies in all. Pile carpet. Three small ground glass windows per side, over large ventilation louvres so constructed as to prevent vision. Water cabinet behind driver's cab. Driver's seat with accommodation for three, and high doors. Electric fan and interior lighting. Roof luggage rail. Spare wheels carried under floor. Other details as touring cars and open coaches.

RELIABILITY.

AT no time more than the present perhaps, has man been seeking to find that on which he can rely. On all sides old theories, formulæ and dogmas which have been accepted without question for centuries are now being subjected to the most rigorous examination, criticism and discussion. Nor is this search after reliability confined merely to doctrines, theories, and such like. Men and women on all hands are making reliability one of the principal if not fundamental qualifications of their selection.

It is, therefore, no wonder that in the Engineeing World, too, the cry to-day is for materials and articles on which absolute reliance can be placed. After all, if one is midway across the Atlantic in an aeroplane when the failure of a mere tightening screw may mean disaster, it is of infinite moment to know that dependence can be put on such a screw. For this reason it is not enough to know that the machine is constructed by some really reliable maker, but that the screw itself is made of some material of unquestionable quality such as "Delta" Bronze No. IVE. Then, too, in the motor world the same search after reliability is seen. It is not so much now the fastest, the cheapest or smartest car that attracts the buyer, but the car on which he can rely. The makers are, of course, fully aware of this and are consequently giving up the idea formerly held in some quarters that so long as the "wheels went round" that was all that was required. Old uncertain methods of manufacture are being discarded and replaced by new. For example, brass castings which might or might not contain a flaw are being replaced by "Delta" stampings, that is to say metal parts made by the Delta Metal Co., Ltd. (London and Birmingham), by forcing plastic metal under great pressure into steel dies, thereby eliminating any possibility of air cavities, etc., and possible failure when in use. The wind screens must be constructed with glass which does not splinter if broken and with frames made of extruded sections of which the Company just mentioned are the pioneers.

Ships must no longer have their fittings made of iron or steel, which are likely to silently and subtly corrode and finally bring disaster and death to many. The fittings instead must be of some material which has proved itself by years of actual use to be unaffected by corrosion. Amongst materials of this kind "Delta" Bronze No. IV. stands out as the one which has quite a unique position in this respect. Nor is it only the mere method of manufacture which the engineer and architect is now careful to specify in his search after reliability. He has learnt by bitter experience that he can no longer trust such catchwords as "equal to" or "superior to." He knows that if safety is to be ensured he must specify a brand on which from his own experience he can depend. With the non-ferrous metals this is peculiarly necessary owing to a rather exceptional set of circumstances. After the outbreak of the late war there was, as everyone knows, an unprecedented demand for non-ferrous metals for the making of ammunition parts and armament components. For several years prior to the commencement of hostilities the production of these non-ferrous metal bars, tubes, pressings, section, etc., had been largely in the hands of a few firms among whom perhaps the best known was The Delta Metal Co., Ltd. The latter had not only acquired a world-wide reputation for the reliability of its products, but had also through the inventions of its late founder, revolutionised the methods of manufacture. Owing to the huge quantities of these non-ferrous products which were required, and the ease with which financial assistance could in certain directions be obtained for installing plant for the manufacture of munitions, a large number of firms took up the manufacture. Not only were some of these totally ignorant of even the rudiments of manufacture or entirely lacking in the necessary technical knowlege for the production of reliable bars and sections, but the very makers of the plant were often completely unaware of the developments in the detailed construction of the machines since the original patents had been taken out some twenty years previously. The result was, as can easily be imagined, that an immense number of highly unreliable and unsatisfactory metals found their way on to the market.

It has, therefore, come about that consumers are careful now if they want a dependable metal to specify that it must be made by some well-known makers, like the originators of the extension process, The Delta Metal Co., Ltd. It is at least satisfactory to know that this firm at any rate has put the reliability of its products in the forefront, and those in our great engineering industries have only to specify their (The Delta Metal Co., Ltd., of London and Birmingham) manufactures to ensure obtaining really reliable goods. In architecture, too, the day of trying any new commodity seems to be passing, and those responsible are returning to the well-known and tried materials which have stood the test of time. Not so long ago amidst much clamour it was proclaimed that stainless steel was the one and only thing for the restoration of old buildings and for the reinforcement and embellishment of new. Now it has been found that under certain conditions the steel is by no means so rustless as its name implies, and, moreover, the concrete or cement does not adhere to it as it does to the time-honoured and much more resistant "Delta" Bronze No. IV.

PISTON TROUBLES.

JOHN SMITH, ESQ., sat at the wheel of his excellent modern car, his hands and feet responding instinctively to the needs of the moment, his senses alert. Being alone, he listened without enthusiasm to a continuous metallic tap from his engine—a tap from which he had no means of escape, and which was rapidly becoming an obsession to his dormant brain.

He had reported that tap to his garage and had received no less than three different explanations therefor, had had the car in dock for a day and had paid two bills for repairs and adjustments. The tap had become slightly worse. John Smith, being a lay member and not an engineer, was troubled, wrathful and vaguely self-depreciatory. He felt like a bull with a particularly vicious gad-fly attacking his rear. He was divided in opinion as to whether he ought to continue to run the car in such a condition, whether he ought to

ship it back to the seller, or whether he ought to just drive along and damn the consequences. And the tap went on tapping.

That tap was piston slap. Nothing serious at the moment, but with promise of becoming so in the near future. It denoted that the piston did not fit the walls of the cylinder in which it moved so rapidly—that a certain amount of power was being lost and a certain amount of undue wear taking place in a portion of the engine where wear would do most harm. It was the most common fault of the modern, high-speed revolution engine, the weak spot of that somewhat small engine that nestled within the big bonnet and gave forth such remarkable power.

THE NEW CURE.

Naturally, this weak spot has been receiving the attention of motor engineers in all car-producing countries. And, just as naturally, it is England, the country which produced the engines for the fastest car and the fastest 'plane in the world, that solved the little difficulty. An 18-50 h.-p. 6-cylindered car is now being built by the Star Engineering Company, of Wolverhampton, England, which, it is claimed after exhaustive tests, is absolutely immune to modern piston troubles.

In this 18-50 Star model, the cylinders are not part and parcel of the cylinder block itself, but are six separate barrels, pressed into the main block and secured by the cylinder head at the top and by a special leak-proof joint at the bottom. These barrels consist of a specially hard chilled iron, far too hard for a whole cylinder block to be cast from it, cast centrifugally in order that all impurities may be deposited, and machined all over to exact identical limits.

The difference between these cylinder barrels and the ordinary walls of a cylinder block lies in the fact that it is practically impossible to cast a four or six-cylinder block with walls of exactly equal thickness, and equally impossible to cast such a block in a sufficiently hard material of pure quality. When heat expansion takes place, therefore, the thicker portions of the walls expand more than do the thinner portions and an uneven passage is presented to the aluminium alloy piston. Friction, damage and "slap" naturally result—and obstruction in the cylinders is obstruction in the heart of the engine.

Such has been the cause of piston trouble in the past. But the new barrel cylinder is *distortionless*, because it is machined to exactly the same thickness at all points. When it expands under heat, it expands absolutely evenly and presents an undistorted surface. Further, the Star barrels are finished by honing instead of by grinding, and honing is a cold process, whereas grinding is a hot process that alters the actual composition of the metal on the surface and thereby doubles the effect of wear. Then the Star aluminium alloy piston is diamond finished to an extraordinarily glossy surface, and this means that neither piston nor wall has any abrasive left in the pores of the metal.

THE RESULT.

The final judge of all car improvements is the actual road itself, and the road performance of the 18-50 Star is all in keeping with the promise contained in the Specification. Speed up to 73 m. p. h. and 60 m. p. h., on top and third gears, respectively, is attained with an ease and lack of vibration and noise that is truly unique, whilst the traffic slow running is equally fascinating. With the eyes shut, it is impossible for a passenger to state whether the car is running at 60 m. p. h. or at 20.

Now, such a perfection as this would ordinarily be regarded as a more or less evanescent bloom due to careful tuning, even with the most expensive models of the day. But in the 18-50 Star the condition is apparently permanent. Of course, design, beautiful balance, a 7-bearing crankshaft, and exceedingly careful hand-fitting are all partly responsible for this most happy result, but the permanence of the beautiful running is undoubtedly due mainly to the prevention of wear in cylinder walls and pistons.

And there is just one other little point where the Star cylinder wall scores. The running of the cooling water in the water jacket is a *full* flow to the head of the engine, but is a *restricted* flow to the cylinder barrel walls. Which means that the part of the engine that requires heat obtains it, without danger to those working parts likely to suffer from it. A little point, and simple, but wonderful in its effect upon efficiency and speedy full-power production.

The Gazettes.

Burma, January 26, 1928.

Buildings and Roads Branch.

Prior to assuming charge of the Construction Subdivision, Rangoon Division, to which he was posted, Mr. Todar Mal Talwar, Assistant Engineer, was attached to that Division from 19th October 1927 to 30th October 1927.

Mr. F. G. Burns, I. S. E., officiating Executive Engineer, Brickfields Division, is, as a temporary measure, appointed to the charge of the Rangoon Estate Office, in addition to his own duties, *vice* Mr. N. D. Howe, Temporary Engineer, proceeding on leave.

Leave on average pay for eight months and in continuation thereof leave on half average pay for one month, for a total period of nine months, is granted to Mr. A. G. T. Taylor, I. S. E., Assistant Executive Engineer, Rangoon Courts Division, with effect from 1st February 1928, or such subsequent date as he may avail himself of it.

Leave on half average pay for two days is granted to Mr. R. C. Bonnaud, I. S. E., Executive Engineer, Rangoon Division, in extension of the leave granted him previously.

Leave on average pay for twenty-nine days is granted to Mr. T. D. Boldy, Temporary Engineer, Electrical Branch, with effect from 1st February 1928, or such subsequent date as he may avail himself of it.

Bihar and Orissa, February 15, 1928.

Irrigation Department.

Mr. J. Shaw, Assistant Executive Engineer, is placed on special duty in connection with the Orissa Flood Committee, with effect from 11th January 1928, with his headquarters at Cuttack.

Mr. E. L. Glass, Superintending Engineer, who has been transferred from the Central Provinces to Bihar and Orissa, is appointed to officiate as Chief Engineer and Secretary to Government in the Irrigation Department, with effect from 19th January 1928. Mr. E. L. Glass remained attached to the Secretariat on 17th and 18th January 1928.

Punjab, February 17, 1928.

Buildings and Roads Branch.

Mr. Balwant Singh Duggal is appointed to officiate as Junior Professor of Mechanical Engineering, Maclagan Engineering College, Moghalpura, with effect from 20th January 1928, the date on which he relieved Captain H. W. Whittaker, Principal of the College, of the additional charge.

On return from leave, Mr J. E. Robinson, Sub-Engineer, reported his arrival in the Rawalpindi Provincial Division on 6th January 1928, joined the Jhelum Subdivision of that Division on 12th January 1928, and took over charge of the Subdivision on 16th January 1928, from Mr. M. A. Ghani, Temporary Assistant Engineer, transferred.

Hydro-Electric Branch.

Captain R. D. Keane, R. E., Assistant Executive Engineer, Punjab Public Works Department, Hydro-Electric Branch, is declared fit to hold charge of a division, with effect from 9th August 1927.

On transfer from the "M/C" Subdivision, which he left on 1st November 1927, Mr. D. P. O'Kelly, Assistant Executive Engineer, joined the "C" (Construction) Circle and took over charge of the "M/M" Subdivision under the direct control of the Circle on the same date from Mr. A. B. Wemyss, Stores Officer, who remained attached to the Circle.

Irrigation Branch.

Lala Amrit Rai, Assistant Engineer, on transfer from the Kirana Division, Lower Jhelum Canal, which he left on 3rd January 1928, joined the Majitha Division, Upper Bari Doab Canal, on the 5th idem.

The undermentioned Assistant Engineers, who were appointed to the Punjab Service of Engineers *on probation*, are confirmed :— Lala Hari Lal Sally, 1st British Circle, Sutlej Valley Project ; Lala Panna Lal Malhotra, 2nd Bahawalpur Circle, Sutlej Valley Project ; Lala Anant Ram Talwar, Derajat Circle.

The following officers of the Public Works Department, Punjab, Irrigation Branch, passed the Departmental Professional Examination prescribed in Article 11 of the Irrigation Manual of Orders, on 8th November 1927 :—L. Sadari Lal Malhotra, Assistant Executive Engineer ; Pandit Khushi Ram Sharma, Assistant Engineer.

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INDIAN ENGINEERING.

SATURDAY, MARCH 3, 1928.

MR. C. G. PALMER, C. I. E.

II.

AT the time that Mr. Palmer joined the Irrigation Branch, the North-West Provinces, as far as irrigation in Northern India went, held the blue riband of prestige. Sir Proby Cautley of the Ganges Canal, who might be called the father of modern irrigation canals, had been followed by a group of irrigation engineers, full of enthusiasm for their duties and eager to maintain and even to add to the reputation of the Provinces in which they had been trained. In the Panjab, irrigation came later, and from time to time a good many senior officers were transferred there from the North-West to strengthen the Panjab establishment. A day arrived when the Panjab infant, by reason of the splendid opportunities it possessed, knew more than its master; but for a period the North-West Provinces held the pride of place and were the source of instruction. Still, that did not prevent mistakes being made, mistakes were inevitable. In the matter of railways, numbers of the ablest men in Europe and America had long been engaged in bringing every detail to perfection, and Indian engineers had the advantage of their previous labours; but in irrigation engineering India had to rely on herself alone, and the best of her canal engineers had to fight their way through their errors to the light. It was so in the North-West, canals had been given longitudinal bed slopes too steep, Cautley's "ogee" falls caused excessive scour, drainage had been badly neglected, seepage was on the increase, duty of water was extraordinarily low, and irrigation outlets were far too numerous and were mainly square tubes of wood. The drought of 1877 threw a heavy burden on the canal officers, the art of distribution was then only imperfectly understood, and owing to the way that men were pressed to remedy defects, many men broke down under the strain. Mr. Palmer had a laborious time under Mr. J. S. Beresford, who was bent on remodelling operations. He had for one thing to take careful and frequent discharge measurements of all canals and distributaries, the results of which were afterwards incorporated in what was known as "Palmer's Discharge Book;" and worked almost to death, he took two years' furlough in 1878 and went to Australia with the intention of not returning to India.

For about a year he travelled over Australia and Tasmania, and in Tasmania he found himself separated from his remittances. In that position he was overjoyed to find, inasmuch as it gave him a feeling of independence and self-confidence, that he could support himself quite well until he re-established connexion with his funds. A little later, he started a brick manufacture near Adelaide in South Australia, and was doing a good business when he fell in love, and that altered the complexion of affairs. He became engaged, and he married, and then, as the brick

enterprise called for more capital than he possessed, he sold out and decided to return to India at the expiration of his leave. His second tour of irrigation service was not very eventful, except that he obtained some *kudos* for his novel groyne-protection at the head of the Eastern Jumna Canal which proved a great success, and also received the thanks of Government for his report on certain torrents in Bhartpur. But it is more important to record that in 1895 he was promoted to the rank of Superintending Engineer in the Buildings and Roads Branch of his Provinces, in which post he found himself confronted with famine work. Following a series of poor harvests, the rains of 1895 closed prematurely. The winter rains altogether failed, and there was scarcity in seven districts, five of which were in Mr. Palmer's circle. Under the Famine Code, a Superintending Engineer had no concern with relief works until they were too extensive for the Collectors to manage. When that occurred, the works were to be administered by the Public Works Department. But Mr. Palmer, who was very quick in his perceptions, foresaw the difficulties that would arise if large works were handed over to him unexpectedly and prepared himself for all eventualities. The scarcity was not at first severe, but none of the officials concerned had any previous experience, and it had three notable results. It trained a large body of officials in the management of famine works; it taught all India the value of permanganate of potash as a disinfectant in a cholera epidemic; and it led Mr. Palmer, who was impressed by the faults and omissions in the Famine Code of that time, to draw up a complete set of instructions which, approved by the Government, formed the basis of the new Code.

To Mr. Palmer is due the credit of using permanganate of potash on a large scale for the first time in India. The scarcity had been followed by an outbreak of cholera and the medicines administered appeared to be of little or no avail. Sickness continued to increase and spread, and Professor Hankin, Government Bacteriologist at Agra, whom Mr. Palmer consulted, suggested trying permanganate and prepared a set of instructions for its use. Mr. Palmer had the instructions translated into Hindi, trained men to act in accordance with them, and endowed every well with a monthly salary for a selected Brahmin who was placed in sole charge. The Brahmin had to disinfect the well weekly, draw the water, and run it through sheet-iron gutters into the vessels of the people. Eventually, all the wells in an area of over 15,000 square miles were covered, about a ton of permanganate was used, and the cholera ceased almost by magic. The Sanitary Commissioner of the time drew attention to the small mortality from the disease, and attributed it to the great care in sanitation and particularly to the pure water supply on all relief works. But though the cholera epidemic had been successfully countered, the scarcity continued, insufficient rain fell in the monsoon season of 1896, and by the end of October it was evident that the Provinces were in for a famine of great severity. On the 1st November 1896, the attendance on Mr. Palmer's works was 19,757; by Christmas the number had risen to 167,361; by the beginning of February 1897 the figure was 506,655; and the maximum, 777,016, was reached on the 29th May. June showed almost equally high figures, and it was not till after the good rainfall at the end of July and in August that the attendance dwindled rapidly. The sum spent by Mr. Palmer on his relief works, mainly on roads and tanks, was Rs. 91,38,740.

The work had been very arduous, involving continuous camping out in any shelter available and in all weathers. A new feature of the campaign, introduced by Mr. Palmer, was the feeding of children under seven years of age. It had been observed that numbers of half-starved children were being stuffed with food by their parents with the result that they died a day or two after their arrival on the relief works, and Mr. Palmer obtained the permission of the Lieutenant-Governor to adopt measures to stem the evil. He brought into consultation with him certain selected fatherly farmers, and after discussion with them a dietary and means of cooking and distributing food were settled and adhered to in all strictness for the remainder of the famine period. It was no small undertaking, the total number of children so fed amounted to 2,229,259 units of one child for one day; the greatest number fed on any one day was 43,760; and at one time over 40,000 children were receiving two cooked meals a day, prepared and distributed at 283 different places scattered over the 15,000 square miles of country. It was in ways such as this that Mr. Palmer's services were so valuable. He was full of resource, he had sympathy with the people and they had confidence in him. He spoke their language almost as well as he spoke his own, and in spite of the strain of a very anxious time he maintained his health and his buoyant spirits throughout the whole period.

Sir Antony MacDonnell was an officer of great administrative ability, and no doubt he was not without knowledge of famine administration; but that form of knowledge differs considerably from the knowledge that is required for practical management in the field, and Sir Antony was quick enough to see what an invaluable lieutenant he possessed in Mr. Palmer. In the Gazette of 18th December 1897 he recorded: "Mr. C. G. Palmer was acting Superintending Engineer of the 3rd Circle during the famine of 1896, and Special Superintending Engineer during the famine of 1897. His charge was the heaviest in the Province, and he has borne a leading part in both famines. Of him I cannot speak too highly. His energy, power of organisation, and careful regard for the interests of Government on the one hand and the people on the other have left nothing to be desired. His assistance to Government in preparing draft rules for works controlled by the Public Works Department and by the Civil officers have been invaluable." These words, deserved to the hilt as they were, were strong for Sir Antony who never praised without strong reason, and Mr. Palmer received the honour of the C. I. E. and the thanks of his Government and of the Viceroy for his famine services.

(To be continued.)

IN MEMORIAM: ARTHUR HICKS.

DURING the winter in England it has been usual for the Coopers Hill Society to hold a gathering of its members on the afternoons of the third Wednesday in each month, and they have always been pleasant social meetings for Coopers Hill men and their relatives and friends. But a gloom was thrown over the January event by the news which had been received that Arthur Hicks lay a-dying. It was not altogether unexpected, for when, a short time ago, Mr. Hicks had asked to be relieved of the Secretaryship of the Society, which he had himself founded and tended with unceasing solicitude for many years, because he was very tired, it was felt that the end was very near. It was not like him to be tired, he had always, whether in his work or in the College sports, thrown his whole heart into the business of the moment and taken the last ounce out of himself; and it was unspeakably pathetic that on that afternoon of January the 18th, when his life was just flickering itself out in gasps, he should have been fretting that he was not able to be with the brotherhood he had never failed before. Ten days later, on January the 28th, he died.

Mr. Hicks passed into the Royal Indian Engineering College, Coopers Hill, in 1875, and a student of some distinction he obtained his appointment to the Public Works Department of India in due course. He was posted to the Buildings and Roads Branch of the Panjab, and would unquestionably have made his mark as an engineer if for private reasons he had not resigned the service in 1887. A short time afterwards he succeeded Professor Thomas Eagles as Instructor in Geometrical Drawing, Estimating and Architecture at Coopers Hill, and it was work that made a special appeal to him. Coopers Hill men have always been remarkable for their strong attachment to their College bond, but in none of them was the *esprit de corps* so intense as it was with Mr. Hicks. To be back within the familiar walls was the very goal of his desires, he loved the atmosphere of the place, and he resumed the old life almost as he had left it. The only change was that he was a teacher not one of the taught, but he had stroked the College Eight and he was now President of the Boat Club, he played in the tennis team, he edited the Coopers Hill Magazine, no one had ever been so part and parcel of the institution as he was in his heart of hearts. Everything that affected Coopers Hill and the men connected with it was his concern, it was a case of *non sibi sed rei publicæ*, not of the welfare of himself but of that of the body, and to that ideal he was ever faithful. The abolition of 1906 was a great blow to him, but even then, though he had to enter fresh arenas of work, he did not let Coopers Hill go. He founded the Society, he continued the magazine, he arranged the annual dinners, the garden parties, the winter meetings, and kept himself in touch with Coopers Hill men all over the world.

As we said when we reviewed Mr. Hicks' career in our series of memoirs, it might not be thought a very great career. But to achieve greatness is often also to incite envy, and no Coopers Hill man could possibly envy Arthur Hicks any more than a family of children could envy their Nanny for her unremitting care of them. He had his eye on the Coopers Hill family, not saying very much but observing their glees and glooms, looking at them with sad eyes when they were bad and with glad eyes when they were good, regarding their antics with kindly tolerance, and when they fell asleep for the last time tucking them away and writing nice obituary articles about them, telling the world what fine fellows they were. Not many men could have done that in the way that Arthur Hicks did it, and now that he is dead the news will have been received with a widespread sense of loss. He was laid to rest on the 1st of February, and a wreath of violets and daffodils bore the words : "From Coopers Hill men in affectionate remembrance of fifty-three years of unbroken friendship."

THE METEOROLOGICAL DEPARTMENT OF INDIA.

III.

AMONG the recent changes and sanctioned or proposed extensions of operations in the Department is the removal of the headquarters from Simla to Poona. For fifty years or so the Department has been shifted through a series of temporary quarters in Simla, as if its convenience were a matter of very small concern. A Department of the Government of India, it had been held, and not unreasonably, that it should be located at the summer headquarters of the Government, but little consideration was paid to the question of a suitable building, and the last house occupied became still more unsuitable when new activities arose. Sir Gilbert Walker, shortly before his retirement, had pointed out that the previous methods of forecasting had shown limitations and that the time had come to make improvements. The processes at work in the atmosphere being essentially physical, it was necessary to undertake the measurement of character of air currents throughout their depths by means of balloons and recording instruments, and as for work of that description Simla was unsuitable removal of the headquarters to the plains had become advisable. Some place in the direct line of the monsoon was wanted so that officers could get personally busy on research to improve knowledge of upper-air monsoon conditions with a view to accurate forecasting. Sir Gilbert proposed Poona as a suitable locality, he was supported by Mr. Field, and in 1926 the move was sanctioned. The designs for the new office have since been prepared by Messrs. Stevens and Partners of Bombay, and it is understood that the over-all expenditure, including removal expenses, will be Rs. 10 lakhs. The change of headquarters is undoubtedly needed, the new office will be a vast improvement on the temporary office at Simla, and in addition there is the satisfactory sign that the Government is now prepared to be more liberal with funds than in past years.

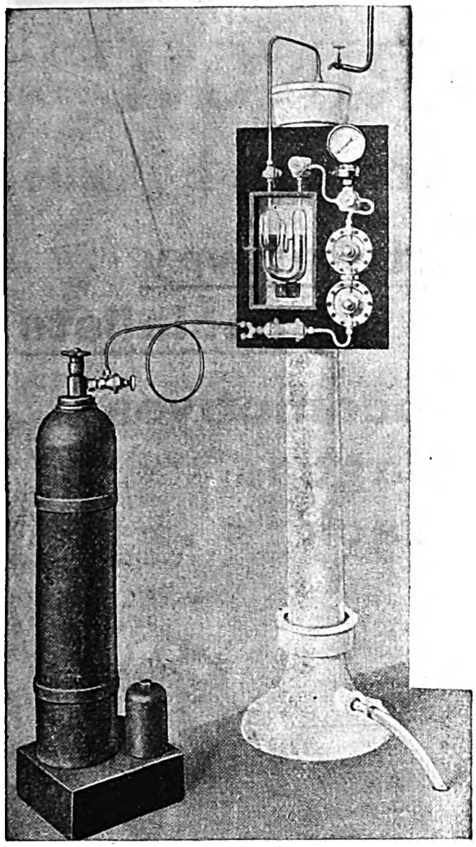
Another, and smaller, building scheme, which is still under consideration, is in connexion with the work at Agra, to which allusion has already been made. The Agra building, at which Mr. Field did

much valuable work, is a *kacha* structure, and it was constructed as such in 1912-13, frankly with the intention that it should last ten years, the period of the first sanction of upper-air work. But the building is not only still required, it has assumed greater importance. It has been found necessary to establish fifteen further pilot-balloon upper-air stations in India and at Seychelles and Aden for general weather purposes and for flying internal to India. These increase the work at Agra, where hydrogen gas is made electrically and compressed for transport to all stations in India and Burma. The original staff at Agra has been nearly trebled, the building is now overcrowded, and more working space and some residential quarters for the night-working establishment are required, the cost of which is estimated at about three-quarters of a lakh. The resumption of two officers at Kodaikanal has also been proposed, there used to be two and the equipment for two research officers is adequate, but financial retrenchments led to the reduction of one officer and to uneconomical results. The adoption of Calcutta as the executive storm-warning office for the Bay of Bengal has, however, been accepted. Originally, there had been at Calcutta a half-time officer only, and the system failed, not infrequently, to give creditable results. The Department felt that it would be useless to apply for increased staff, in fact financial stringency forced the Director-General to attempt to do the cyclone warnings from Simla with indifferent results, and on further representations being made, three whole-time officers at Calcutta have been sanctioned. Successful too appears to have been the Department's proposal for adequate officers and sub-staff at Karachi and in the Persian Gulf in the interests of Empire flying. Two officers have been appointed, one of whom is on deputation to England, Norway and Germany to acquire home experience, and eight stations in the Persian Gulf are in course of starting, including three upper-air balloon stations. A more intensive application to marine meteorology has for some time past been desired, and has only been prevented by want of funds to meet the need. A special officer for the purpose has now been engaged. There is one more undertaking, long overdue, which has been hanging fire, owing, it is understood, to the expense entailed. It implies a detailed weather experimental research in north-east India with the object of investigating the reasons for the destructive nor'westers (tornadoes) which from time to time devastate portions of Chhota Nagpur and Bengal. For aviation forecasting in England and on the Continent of Europe, it has been found that comparatively close net-work detail is required, and in India there is the same necessity. In the opinion of the Department's experts, it is necessary to start on a modest scale, and to enter into great detail over some one tract of country, before any real idea can be formed as to how much precision in aviation forecasting is possible within a reasonable cost, and the north-east area has been chosen as it is on a flying route and is subject to tornadoes. The cost of the research to occupy a period of two years is estimated at £6,000, which, though it might be thought to be a large sum for India, would be nothing in the West.

With these and other new lines of activity in being or in contemplation, it is unfortunate that the Department should have lost an officer of Mr. Field's scientific and administrative abilities. He had reached the superannuation age, but no man ever retired under the age rule with better physical and mental health or with such unabated zeal for work which was the natural vocation of his life. He is also a man who commanded the confidence and respect of his staff in an unusual degree and therefore obtained the best of work out of them. If he had felt that on his appointment to Director-General of Observatories, the administrative duties would be uncongenial to him, it was during his tenure of office that many administrative advances were made, and the only pity is that he should not still be at the helm to see them a stage further. He has been succeeded by Dr. Normand who, with the exception of Dr. Royds on special work, is the last of the British officers in the service, and the good wishes of everyone will go out to him in the not too easy task which, in all the circumstances of the present time, he has to face.

TREE BENCH MARKS.

"THE INDIAN FORESTER" of last December has an article by Lieutenant-Colonel U. R. Cotter on the experiments in use of tree bench marks carried out by the Survey of India at Dehra Dun between the years 1914 and 1926. The investigation was due to the success of tree bench marks in Canada, and it was desired to see the behaviour of such bench marks in India. It is not often that levelling is wanted in forest areas, and even if there are no permanent structures on which bench marks can be inscribed there are usually sites where the marks can be constructed. But, occasionally, conditions may be encountered in which tree bench marks would be useful, and they have been found useful in Canada. They were not used in Canada on lines of precise levels, unless for purposes of temporary reference; but were used during the survey of the initial meridians and base lines in advance of other surveys, when it was often out of the question to establish really permanent bench marks, except in rare instances when there was rock available. The conclusions of the experiments made in India were that tree bench marks should always be placed on heart wood, not on wood below the bark of a tree or on the bark; that they should not be included in lines of levelling of high precision, though groups of five or more may be included in branch lines; and that for levelling of secondary precision a tree bench mark is sufficiently good. The group system has its uses in crossing jungle areas. There might be rest houses or clearings of sorts even ten or fifteen miles without any kind of permanent mark in the intervals, in which case a series of branch lines, with groups of five or six tree bench marks on each, might be the only solution in order to retain good values for canal or road engineers for the future.



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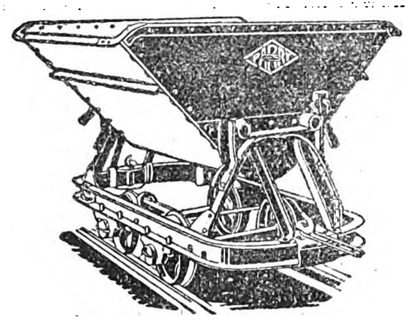
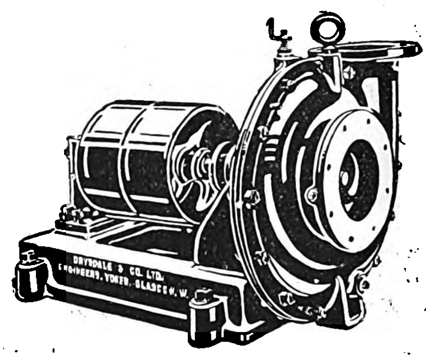
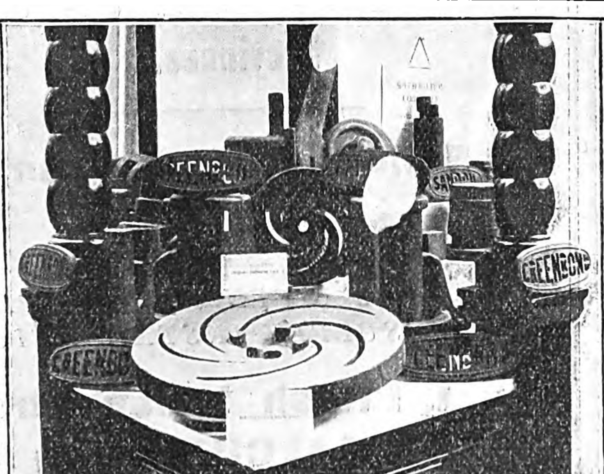






Notes and Comments.

The Acme Manufacturing Co., Ltd.—This Company of Sleater Road, Bombay 7, draw the attention, in a leaflet, of architects and building contractors to their Acme fittings. A few of the lines the firm specialise in, such as building fittings and fixtures, hollow-ware in brass, aluminium or germansilver, machine parts and accessories, silver plating, etc., are given. The company also specialise in nickel-plating, silver oxidising and plating, copper oxidising, etc. All Acme products are of the most choice designs.

Anglo-Iraq Relations.—Muzahim Bey, Diplomatic Agent for Iraq in London, has been recalled to Iraq, and Jaffar Pasha, who resigned the Premiership last month on the publication of the terms of the Anglo-Iraq treaty he had been concerned with while in England and the consequent disturbance caused by it, has been appointed Agent in London. Muzahim Bey says he is "against the mandate and dead against the treaty." He wants the mandate revoked, the capitulations abolished and a treaty concluded recognising Iraq's complete independence.

Indian States.—Sir Leslie Scott, K. C., M. P., left London on 29th December for India to advise the Indian States and Princes as to their legal and constitutional positions with regard to the Statutory Commission and as to the evidence they are to lay before it. A fee of £53,000 plus £200 a day during the three months he will be away is to be paid to Sir Leslie Scott. The Indian States will pay over Rs. 9 lakhs for his advice, but they have secured what is most important at the present crisis, the services of one of the best known K. C.'s at the English Bar.

Separation of Sind.—At the All Parties' Conference held at Delhi on the 15th February, to discuss Hindu-Moslem relations, Sir Tej Bahadur Sapru is reported to have made the suggestion that a small committee should be appointed to examine the question of the separation of Sind and to report at an early date. Whether Sind elects to become independent or to amalgamate with the Punjab, it would be well for her to come to an understanding with the Province whose interests are almost identical with hers. If Sind joins the parties who say they intend to boycott the Simon Commission they will be heading for a difficult position in view of the attitude of their manly neighbour towards the enquiry being opened by the parliamentary commission.

Financial Stringency in Bombay.—A strong attack was delivered in the Legislative Council on the 21st February, in discussing the Budget, by the non-official members. All parties pronounced the state of the finances of the Presidency to be most unsatisfactory. The Development Department was severely criticised. The Government were taking greater care in the carrying out of the Sukkur Barrage works as they had learnt much from the sad experience of the Back Bay schemes. The Budget deficit shown as Rs. 34 lakhs, it was declared, did not represent the actual state of the finances. The total revenue for the year 1928-29 is estimated at Rs. 1,526 lakhs and expenditure at Rs. 1,560 lakhs. If the expected remission of Rs. 37 lakhs, which is the provincial contribution still due to the Government of India, is remitted, there will be a small surplus on the right side.

The Bagh Caves.—In the Indian Empire there are now only three places where old Buddhist art in the form of paintings survives, the caves of Ajunta in the Deccan, the Bagh caves of the Gwalior State and some caves in Ceylon; and a recent publication of the Indian Society, London, on "The Bagh Caves in Gwalior State" is very welcome as giving an excellent description of these cave temples of the sixth century. There are nine caves of the group, and they are cut into the sandstone cliff of the Bagh river, extending over a frontage of 750 yards or so. The roofs of the caves are supported by columns, and there is some sculpture, though not of very great importance. The interest of the caves lies mainly in the paintings which are of very high quality, almost equalling the more famous paintings of Ajunta. The paintings are reproduced in colour in the book, and will prove to be a valuable record of a splendid ancient art when time has caused it to disappear.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 16th February :—Messrs. Paterson Engineering Company (India), Limited, Bombay—1 Chloronome, Paterson Pulser type, complete with all fittings, Rs. 4,150 f. o. r. Kathgodam; Messrs. Martin and Company, Calcutta—Spares, for Ruston 300 Dragline Excavator, Rs. 4,671 c. i. f. Karachi; Messrs. Stewarts and Lloyds, Limited, Calcutta—5,000 r. feet Piping, lapwelded, galvanised steel, 4 inches bore, 6 S. W. G. thick, in 13/15 feet lengths, complete with Victaulic joints, Rs. 8,906, free delivery at Park Siding, Quetta, by 26th May 1928; 15,500 r. feet Piping, lapwelded, galvanised steel, 4 inches bore, 6 S. W. G. thick, in 13/15 feet lengths, complete with Victaulic joints, grooved type, and 5 per cent. joint rings, and bolts and nuts, Rs. 27,609 free delivery at Park Siding, Quetta, by 26th May 1928.

Britain's New Silver Coins.—Specimen sets of the new silver coins from the British Royal Mint are gradually being issued to those members of the public who applied for them. The special sets of six coins comprise crown, half-crown, florin, shilling, sixpence and threepence. It is interesting to learn that quite a number of applications have been received from large firms for supplies of crown pieces for the payment of wages. The British public is justly proud of its coinage, both as regards design and manufacture. It may almost be said to represent that high standard of quality for which so many British engineering products are renowned. That this is recognised far and wide is proved by the fact that the mints of so many foreign countries have been equipped with British machinery. Thus, practically all the machinery in the Italian Mint was supplied by Greenwood and Batley, Ltd., of Leeds, who have also been responsible for complete minting plants to the Governments of France, Turkey, India and Afghanistan.

Bombay Finances.—On the 23rd February the proceedings of the Bombay Legislative Council assumed a lively aspect when the administration of their portfolios by some of the ministers came to be assailed with criticisms. The Excise Minister expressed his readiness to accept reasonable suggestions and invited the non-official members to point out mistakes. Mr. Nariman here interjected: "And be prosecuted for it!" Mr. Nariman attacked the Development Department, whose activities were the prime cause of the parlous state of the finances of the Province. He strongly criticised the

official benches for not supplying the House with the Auditor's and Accountant-General's report on the Budget. The Finance Member admitted that the Development Department was one of the causes of the unsatisfactory state of the finances, but he chiefly blamed the Meston Settlement, by which the province was deprived of legitimate revenues. In spite of these handicaps the province was far from being in the state despondently described by the non-official side.

The Bengal Budget.—This was presented to the Bengal Legislative Council on the 20th instant by the Hon'ble Mr. A. Marr, Finance Member of Bengal. He described it as a "very unsatisfactory budget" which did not do justice especially to the transferred departments and this was solely due to the burden of the Meston Settlement. The estimated expenditure for 1928-29 was Rs. 75,29,000 in excess of the revised estimate for the current year and of Rs. 91,90,000 above the estimated receipts. The main features are:—A loan of Rs. 39 lakhs from the Government of India for financing the Damodar canal project, the new Council Chamber, the Bally Bridge, improvements to Chittagong port and the Bakreswar irrigation project. Revision of the rates of pay to the lower ranks of the Calcutta police force. A grant of Rs. 6 lakhs for public health organisation in the districts. An additional grant of Rs. 3,39,000 for education. Of a proposed new expenditure of Rs. 16,16,070, Rs. 9,12,272 has been allotted to the transferred departments. The budget as presented is a deficit budget.

The Chamber of Princes.—The Chamber of Princes was opened by the Viceroy on the 19th February. The Conference is this year being attended by 43 Chiefs. The meeting will probably last about four days, and will be of special importance. The position of the States (prominently brought to notice in the recent speeches of the Maharajas of Patiala, Jodhpur and Bikaner) now and in the future will be discussed for the purpose of drawing up a carefully prepared statement of their case for the Butler Committee, which has started its preliminary enquiry. Sir Leslie Scott's services will be available both in connection with the Butler Committee and the Simon Commission enquiries, for laying down the general lines on which it is advisable to proceed. The publication of the proceedings of the Chamber of Princes is being urged by many of the well-wishers of the States, if it is desired to obtain the support of public opinion for the benefit of the Princes and their people while support has hitherto been lacking because of the policy of concealment that has been adopted by many of the States.

Punjab Waterlogging.—In replying to the speech of Mr. Hadow, the president of the Punjab Engineering Congress, held in Lahore on the 22nd February, His Excellency the Governor referred to the progress on Irrigation, Roads and Railways and then touched on Waterlogging, which has been causing the Canal Department such anxiety during recent years. He said they were carrying out their programme for fighting the evil vigorously. In extending open drains they were able to record some very satisfactory results. The areas round Sambrial and Gujranwala on the Upper Chenab Canal had greatly improved. The long and expensive Raniwal drain in Shahpur has already begun to operate and should reach a full measure of efficiency in the present year. Important experiments in the reclamation of waterlogged soil had been undertaken at Chakanwali, where it had been proved that with open drains and suitable treatment with gypsum the soil could be made to bear excellent crops without further irrigation. The Rural Sanitary Board had for some time been engaged in opening up natural drainages and has achieved some results which had been highly appreciated in the areas affected.

Punjab Canals—January.—*Southern Administration Canals.*—There was slight rainfall in all the canal irrigated tracts and in the submontane tract of the Sirhind Canal. The supply of water from the Indus, Chenab, Ravi and Sutlej rivers was insufficient for the canals, but the Jumna provided an adequate supply in the first half of the month. The condition of the irrigated crops was generally good except on the Derajat Inundation Canals, which, including the Sidhnai, were dry. *Northern Administration Canals.*—The weather has, on the whole, been cold and dry, but occasional showers of rain over the area have proved of much benefit to the *rabi* crops. The demand for canal water has been very keen, as is usual at this time of the year, when river supplies are below the capacity of the canals which are being worked rotationally. The state of crops is, on the whole, fair. Considerable work is in progress on the Upper Chenab Canal and elsewhere in connection with measures for the prevention of waterlogging. These include a scheme that has been undertaken so that the water level in the canal may be lowered over large reaches, and the construction of new drains and the provision of pumping outfalls where necessary. The works in connection with the Burala and other extension schemes on the Lower Chenab Canal are progressing satisfactorily, as is also the drainage work on the Upper Jhelum Canal.

Transmission Within Half-an-Hour.—An engineering firm recently were under penalty to deliver a machine they were building within three days' time. At the last minute the essential drive had been overlooked, gears and pulleys needed designing—what about a chain drive? If the firm kept their people working all night making the wheel castings could they be machined and returned to time. Half-an-hour later a Renold Standard drive was on its way and was actually in position on the machine the same afternoon. In these days of acute competition time is money, and it is advantageous to find the quickest way to the best results. The ability to choose a drive from a booklet, order it by telephone by quoting a catalogue No., and getting delivery the next day can be considered in the nature of a boon to all manufacturers using power, no matter how slight. Where there is a motor there is a potential chain drive no matter what the industry, and the firm of Hans Renold, Ltd., have met the requirement of small and large users by standardising a series of drives up to 100 h.-p. Inside each of 14 or 15 ranges a variety of speeds and ratios are available which will be found to suit the normal conditions in any factory. Wheels and pinions are stocked to meet the chain dimensions used in industrial lineshaft and machine driving and for motor shaft sizes as laid down by the principal motor manufacturers.

Blue Nile Dam at Sennar.—On the 28th February, the British Official Wireless says, the Foreign Secretary was again questioned regarding the Makwar Dam in the House of Commons. He was asked what the capacity of the Sennar Reservoir was in relation to the requirements of irrigation in the Sudan Gezira and also how the method adopted of operating the dam affected navigation on the Nile in Egypt and the supply of irrigation water for Egypt during the summer. Sir Austen Chamberlain replied that the

quantity of water stored at Sennar exceeded the requirements of the Sudan by 400 million cubic meters last year and it was estimated that the same surplus would be available for the benefit of Egypt this year also. Were the Sennar Dam not in existence, this additional supply would have flowed unused to the sea, so that the Dam, far from damaging Egypt, had hitherto had the effect of increasing her water supply at a period when it was most required. The arrangements for filling and emptying the reservoir at Sennar, both last year and this, were especially designed to meet Egypt's requirements. They were submitted to and approved by the Egyptian Ministry of Public Works. The reservoir had not affected navigation in Egypt. Such interference as had recently occurred was the result of the recent decision of the Egyptian Government to store greatly increased volumes of water at Assuan.

Railway Budget.—On the 20th instant, Sir George Rainy, Member for Commerce and Railways, introduced this Budget in the Legislative Assembly. The statement shows a record year for traffic in 1927-28 and large reductions in costs, both for carrying traffic and repairing rolling stock. Sir George was in a position to announce substantial reductions in rates and fares with the object of stimulating trade. The chief proposals are:—Reduction of half a pie a mile in third class fares for distances over 50 miles on the North-Western, East Indian and Great Indian Peninsula Railways. Reduction of 15 per cent. in parcel and luggage rates. Reduction in charges for carrying motor cars and live stock. Anomalies in goods rates on the old Oudh and Rohilkhand Railway to be removed. Dealing with the revised estimates, Sir George said that compared with the previous year passenger earnings would be better by Rs. 150 lakhs and goods earnings by Rs. 3 crores. Attention was drawn to an increase of 40 per cent. in the export trade in coal during the first seven months of the year. The final result of 1927-28 was expected to be a gain of over Rs. 12¾ crores from the commercial lines, which is nearly Rs. 375 lakhs more than in 1926-27. With regard to the progress made in Indianisation, Sir George said that Indians were likely to obtain 70 per cent. of the appointments on the State-managed railways this year, which was rapidly reaching the Lee Commission recommendations.

Sales of Punjab Waste Lands.—Auction sales of Government waste irrigable lands on the Lower Bari Doab Canal in the Montgomery District and on the Sutlej Valley Canals in the Nili Bar are to be held during March 1928. On the 6th to 8th March at Pakpattan, 10,377 acres. On the 12th and 13th March at Khanewal, 23,816 acres. On the 21st to 24th March at Montgomery, 11,509 acres. This aggregates 45,702 acres in one month in the Punjab alone—a large area for one partner in the arrangement for restricting land sales to prevent loss by causing a slump in the prices of land to be sold by the Punjab and Bahawalpur State in conjunction in the proportion of one to two for these two partners in the Sutlej Valley Project. The total of 136,106 acres to be sold by the two parties in a single month will operate in bringing about a fall in land values, or (and this the Punjab Government would strongly disapprove of) in the lands more sought after going at good prices and the others remaining unsold or fetching very low prices, the average gradually falling. The reason why the Punjab would feel bound to prevent these results is that it would be the Bahawalpur State that would suffer severely as a direct result of having agreed not to take advantage of the unpreparedness of the Punjab in 1924 and taken the advice of Government to cancel the State's sales at that time, so that both could start selling together in friendly co-operation.

U. P. Council House.—His Excellency Sir Alexander Muddiman, Governor of the United Provinces, performed the ceremony of opening of the Council House at Lucknow in the afternoon of 21st February. On arrival His Excellency was greeted with a salute of guns and received by the Presedent of the Council who presented to His Excellency the Deputy President and the Secretary. Mr. H. A. Lane, P. W. D. Secretary to the Government, presented to His Excellency the architect of the Council House and the principal officials concerned in the construction of the building. After His Excellency had inspected the guard of honour furnished by the Royal Rifle Corps, he entered the shamiana accompanied by his personal staff and the President of the Council. At the door of the Council House Sir Rajendra Nath Mookerjee presented to him, on behalf of the contractors, Messrs. Martin and Company of Calcutta, a golden key with which His Excellency unlocked the building. The Council House was designed by Mr. H. V. Lanchester and constructed by Messrs. Martin and Company, at a cost of approximately thirty lakhs of rupees. The building has a frontage of 700 feet and its height to the top of the central dome is about 100 feet. The Main Council Hall under the dome is designed to seat 300. It is octagonal in plan, 80 feet in diameter and 45 feet high. On either side are spacious division lobbies and on the upper level are seven public galleries.

Thomas Hardy as an Architect.—Mr. Thomas Hardy, O. M., of whom, on the occasion of his death at the age of eighty-seven a short time ago, much has been said in the Press, was a great writer, a great novelist and poet, but it is not equally well known that he started his career as an architect. It was, as far as is known, his own wish, at any rate he entered the office of an ecclesiastical architect, Mr. John Hicks, as a pupil at the age of sixteen, and afterwards studied with Sir Arthur Blomfield, A. R. A. Presumably, he was pretty good because, when he was twenty-two, he won the R. I. B. A. Medal for an essay on "The Application of Coloured Bricks and Terra Cotta to Modern Architecture," and if at twenty-two Hardy was anything like the literary artist he afterwards became, the essay would have been well expressed. Indeed, it may have been his early success as an essayist that led him to discover that after all the use of words was his real vocation. Three years later, while still an architect, he had an article accepted and published, called "How I built myself a House." Altogether he was for about fifteen years engaged in learning and in practising architecture, and then apparently his great gift of writing so proclaimed itself that he abandoned the architectural profession for that of literature. What he would have achieved if he had adhered to his original intention, it is of course impossible to say. There are people who think that he was so skilled in words that he would have expressed himself skilfully in architecture also, and that is not impossible, there have been a good many men who were so versatile that they were capable of giving a good account of themselves in several of the arts. But Hardy no doubt knew the direction in which the strongest call of the blood lay, and he proved to be so great an artist in literature that no one can quarrel with his decision.

Current News.

THE Railway Budget has been passed by the Legislative Assembly.

A WATER supply scheme for Adelaide, Cape Province, is projected at a cost of £35,000.

THE Jhelum Subdivision is retransferred from the Shahpur Provincial Division to the Rawalpindi Provincial Division, with effect from 19th October 1927.

IT is expected that the new power station at Congella, Natal, which includes two 12,000-kilowatt turbo-alternators, will be ready for service some time about April.

THE Government of India have sanctioned the construction of a railway line between Lyallpur and Chamanwala by the North-Western Railway for a distance of 110 miles.

SIR WILLIAM WILLCOCKS, K. C. M. G., will deliver a lecture on "Ancient Irrigation in Bengal" at the British Indian Association Hall on Tuesday, 6th March, at 5-30 P. M.

ANOTHER diamond occurrence of some importance has been discovered in Tanganyika territory, and a company with a capital of £30,000 has been registered to exploit it.

MR. A. M. ROBERTSON has taken over charge as Superintendent of Workshops, B.-N. Railway, from Mr. M. H. Oldfield, and the latter has proceeded on leave prior to retirement.

THE Railway Board have sanctioned the construction by the Assam-Bengal Railway of a line of railway on the metre gauge from Senchda to Mairabari, a distance of 30·25 miles.

THE headquarters of "C" (Construction) Circle, Punjab, Public Works Department, Hydro-Electric Branch, were transferred from Palampur (District Kangra) to Jogindar Nagar (Mandi State), with effect from 5th December 1927.

THE headquarters of T. L/n (Trunk Transmission Line North) Subdivision, Punjab, Public Works Department, Hydro-Electric Branch, were transferred from Chhetru (Kangra District) to Palampur (Kangra District) on 31st January 1928.

THE New Extension area at Bangalore is being developed as a residential district and the Municipal Commissioner of Bangalore City invites applications for particulars of bungalow sites which will be offered for sale on 17th March.

THE construction of a railway between Boitchinovtzi and the Danube port of Kozlodoui, in Bulgaria, is about to be commenced, and it is expected that the work will speedily be completed as very few bridges and tunnels will be necessary.

IN order to stimulate the use of British Columbia coal instead of imported oil in the industries and large buildings of that province, the provincial Public Works Department is starting extensive research into the value of powdered coal as a fuel.

WORK on the construction of the cable-way which is to be built up the side of Table Mountain, South Africa, has progressed to the extent of the construction of temporary trestles and the installation of a rope for the handling of materials on the site.

THE new plan for the fixation of atmospheric nitrogen belonging to Nihon Chisso Hiyro, Japan, has now been completed. The necessary power is to be supplied, from the Takazawa plant, some 28 miles distant, through three 10,000 kVA and three 6,000 kVA transformers.

DURING last year a total of 45,850 square miles of territory in Canada was photographed—28,650 square miles by oblique photography, and 17,200 square miles by vertical photography. The oblique photographs numbered 16,246 and the vertical photographs 46,340.

THE first of three new trackless electric tramcars, supplied by Ransomes, Sims and Jefferies, of Ipswich, to Bloemfontein, has lately been put through road trials successfully. It contains seating for thirty-five persons, and, when necessary, it can be operated by one man.

THERE were at the beginning of this year 191,513 miles of improved roads in the United States, of which 41,020 were paved, with 77·9 per cent. of the latter concrete, 11·7 per cent. bituminous concrete. the others divided between brick, sheet asphalt, and asphalt, wood and stone blocks.

AT a meeting of the Commissioners of the Hooghly-Chinsurah Municipality, the water supply extension scheme framed by the Water Works Committee was approved. The Commissioners decided to meet the cost, which has been estimated at Rs. 1,92.000, by a Government grant, loan and house-connection fees.

MR. T. W. DOWDING, M. L. C., of Messrs. Turner, Morrison and Co., Ltd., has been elected a representative of the Bengal Chamber of Commerce on the Calcutta Port Commission, *vice* Mr. H. C. Edmondson, of the same firm, who has proceeded on leave for eight months and fourteen days from 24th February.

A NEW bridge, costing over £30,000, over the Welland at Spalding, was recently opened by Mr. J. W. Gleed, Chairman of the Holland County Council, in the presence of a representative gathering of public citizens and officials. The main object of the bridge is to facilitate traffic to the Spalding Beet Sugar Factory, the capacity of which has just been doubled.

Literary Notices.

A Manual of Field Astronomy.—By Andrew H. Holt, Associate Professor of Civil Engineering, State University of Iowa. Second Edition. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd. 1927. Price 10*s*. net.

This small and handsome volume, with gilt edges, and which can be conveniently carried in an ordinary coat pocket, is a welcome addition to the many works published on the same subject, and will undoubtedly meet with full recognition of its merits. The author in his preface to the first edition states that if the reason be demanded for the appearance of another book on Field Astronomy, when there are already published several excellent works on the subject, it may be stated as follows: That although any one of them may serve very well as a text for comparatively extended study, the author has been unable to find one sufficiently concise to fit the short time usually allowed for the work in a civil engineering course which would still provide enough of the fundamentals of the subject to enable the reader to make, intelligently, the observations and accompanying computations required in the practice of general engineering and surveying. Something is needed more complete than the usual chapter on books on surveying and less extensive than most texts on field astronomy. This need, which is acknowleged by other teachers to exist, it is hoped to fill; and at the same time it is hoped to provide a book which will be of service to engineers and surveyors whose practice requires that they occasionally make astronomical observations. The second edition is an improvement on the first in very many respects and can be strongly recommended to field surveyors as a most valuable assistance to their work in the field.

Modern Foundry Operations and Equipment.—By William Rawlinson, Foundry Engineer and Director. London: Chapman and Hall, Ltd. 1928. Price 18*s*. net.

The Introduction to this important book states that during recent years there has been manifested on the part of principals and heads of departments in the engineering industry a considerably greater interest in the foundry than formerly was the case. Two factors have largely contributed to this; first, a greater appreciation of the value and importance of the foundry and its products; and, second, the application of scientific methods in the carrying out of the various foundry operations. Too often in the past the engineer has been prone to regard the foundry as a department of secondary importance, and hence his attitude of only general interest. Too seldom have foundry operations formed part of the practical shop experience of the engineer, or the technical side of founding been part of the curriculum in his technical training. This has been to the disadvantage alike of the engineer and the foundry; to the engineer because of his limited knowledge of the details of foundry operations, and to the foundry in that it has lacked in some measure the contribution of ideas and experience that the engineer can give. In this book an attempt is made to survey the work of founding as practised in the production of iron, steel and non-ferrous castings. The method adopted is that of setting forth the principles underlying the various operations, rather than a description of the practical and manual details. For these latter, text-books are already available; if, indeed, the knowledge of the practical side of foundry work can be acquired except by actual manual work in the foundry. At the same time, sufficient details are given to enable an appreciation of the practical side of the subject. Detailed consideration is given of the several metals available for the production of castings, the relative value and application of these for various purposes. The main operations are surveyed as regards the melting of the metals, preparing the sands, moulds and cores, cleaning the castings, and the testing methods followed. In view of the marked progress made, as a result of scientific investigation, in respect of the selection, mixing and melting of metals, attention is given to the many metallurgical considerations involved, and to the recent developments that have taken place. Similarly, the various phases of foundry equipment are considered, particularly as regards moulding and core-making; also the method of cleaning castings by sand blasting. In these the manner of treatment is that of keeping to the forefront the latest developments. In dealing with the subject along these lines the aim has been to provide information and data in keeping with the modern trend of founding, and hence to make the book of value, particularly to principals and managers engaged in the various branches of engineering.

CORPORATION OF CALCUTTA.

NOTICE TO CONTRACTORS.

TENDERS are invited in duplicate for the following and will be received by the 1st Deputy Executive Officer on the date noted for each, up to 2 P. M. Each tender in duplicate must be enclosed in a sealed cover and superscribed—"**Tender for**.................." Specifications with tender forms in duplicate may be obtained during office hours from the Central Record Office on payment of Rs. **2** in each case. For further particulars apply at the Office of the Secretary. Tenderers must abide by the Corporation Rules in regard to tenders.

1. Supply and delivery of a light motor roller for footpaths and playing ground.
2. Supply and delivery of six 5 to 6-ton petrol lorries.
3. Supply and delivery of gas lighting stores (mantles, nozzles, inner glass bulbs, brass adaptation fittings) during the year 1928-29.
4. Supply and delivery of bearing springs, drawbar hook springs, buffer springs, drawbar hooks for wagons and locos., etc., at the Entally Workshops during the year 1928-29.
5. Supply and delivery of wheels and axles required for Municipal Conservancy Railway Wagons.

Tenders for 1 will be opened on 7th March 1928 (Wednesday), for 2 on 12th March 1928 (Monday), for 3 on 16th March 1928 (Friday), for 4 on 20th March 1928 (Tuesday), and for 5 on 27th March 1928 (Tuesday). The rates quoted in tender for 1 are to hold good for five weeks, and those quoted in tenders for 2 to 5 for two months.

N.B.—In the case of item 2, firms who previously submitted tenders for the same will get two copies of tender form free of charge from the Central Record Keeper of the Corporation on production of the receipt granted for the previous purchase.

B. V. RAMIAH,
Secretary to the Corporation.

Central Municipal Office,
Dated CALCUTTA,
The *28th February 1928.*

Foreign Notes.

Transatlantic Television.—Mr. L. G. Hutchinson, managing director of the Baird Television Development Company, who sailed from Southampton for New York on 18th January, is reported to have stated that television had been definitely established between England and America after secret experiments. They had worked from Leeds, Glasgow, Hull, and other places, and had been able faithfully to represent images in London, but the experiments with New York had been carried out with secrecy, and recently they had established contact with New York on several occasions. It was possible to see faces and hands, says "The Times," although the features were indistinct. He was going to the United States to carry out official experiments in Transatlantic vision and to explore the prospects of establishing the system on a commercial basis.

New High-Compression Engine.—A new high-compression engine, said to effect a fuel saving of at least 25 per cent., has been invented, built and tested by Mr. O. W. Hult, the inventor of the Swedish "Archimedes" detachable motor boat engine. The principle employed is that the efficiency of an engine is greatly increased if the cylinder can be supplied with gas at a low temperature at a low pressure. This effect Mr. Hult has obtained by adding an extra cylinder block, in which the gas is first compressed, the heat of compression being eliminated, and then allowed to expand before being fed into the cylinder of the motor. A compression of about 9·6 kilos. per square centimetre is obtained, instead of 6·5 as in the ordinary petrol motor. During the tests the new motor has been shown to reduce the petrol consumption from 280 grammes per horse-power hour to 192 grammes, and in a new four-cylinder motor, now being built, the inventor hopes to obtain an even greater saving of fuel.

Polish National Exhibition.—A universal national Exhibition is to be held in Poland in 1929 to commemorate the tenth anniversary of the independence of that country. The Exhibition will represent all spheres of the national life of Poland, *i. e.*, of the economic as well as of the cultural, scientific, social and sporting life of the country. Polish emigration will occupy an important place, for a special pavilion has been set apart wherein will be exhibited a graphic display of the cultural, economic and political achievements of Polish emigrants, especially in North America and Brazil. The Exhibition will have support of the Government, the President of the Republic having consented to become a Patron, and Marshal Pilsudski, the Prime Minister, having accepted the presidency of the honorary committee. It will also offer many illustrations of Poland's participation in international trade and commerce, the possibilities of expanding her exports and imports, as also her commercial relations with other European countries, including Great Britain.

Weighing by Radio Methods.—One of the latest applications of the radio principle is a weighing machine developed by the laboratory staff of a large New England producer of pulp and paper. This unique device automatically weighs any material, such as paper, rubber, chewing gum, and coated fabrics, passing through the mechanism in continuous web form; the weighing is accomplished at full speed without touching the web of the material at any point, says the A. I. E. E. "Journal." The principles underlying this unusual development are those of the tuned radio circuit: the web of material passes between two parallel metal plates which act as a condenser in the receiving circuit. Variations in the weight of the web change the capacity of the condenser and affect the response of the circuit to a wave of controlled frequency; the variations are shown on a meter in the circuit and may be used to operate the machine controls by suitable relays. The machine is of great service in maintaining uniformity in the weighing of paper, and an adaptation of the device may be used to register the moisture content of the paper. It is obvious that methods of measurement of this description are capable of application to an almost unlimited range of industrial processes.

Town Planning Progress.—According to the "Builder," during the past few months town planning has made a remarkable forward move in England and Wales. Over 3,000,000 acres are now included in town planning schemes that are being prepared by 395 local authorities. When Dr. Addison, soon after the War, put forward town planning legislation, making action compulsory upon all authorities in urban districts with populations of 20,000 or more, it was prophesied by the pessimists that the Act would largely become a dead letter. Events have shown that those authorities who were under no compulsion to adopt town planning schemes already exceed those compelled to plan. The two old Universities have given a lead in this matter. Within the last few weeks a scheme for the east part of the Borough of Cambridge has been approved, and the preservation of the banks of the river Isis has been assured by the approval of the Preliminary Statement for Oxford and District. The growing opposition on the part of popularly elected bodies in England and Wales to greyhound racing is shown by the use made by local authorities of their powers under the Town Planning Acts to prevent greyhound racing tracks being established in districts that are reserved, or proposed to be reserved, for residential use. There has also been opposition to the erection of public garages in beauty spots.

Hydraulic Works in Africa.—The Congrès de l'Eau, which has just been held in Algiers, marks the beginning of a systematic effort to ensure a distribution of water over vast territories in North Africa that at present suffer from long periods of drought. At certain seasons the rains fall in tropical abundance, sufficient to supply the needs for the entire year if the water could be preserved, and in Algeria a great deal has already been done, by the construction of barrages, to remedy the water shortage. The problem is twofold, one being to store the water which falls on the northern slopes of the Atlas Mountains and is sufficient to provide all that is required for irrigation, and the other to proceed with the work of afforestation on the southern side of the range in the belief that that would produce a certain humidity of climate and therefore render productive otherwise arid soils. The disastrous experience of the past month or two has shown how it is possible for huge masses of water to pour down the *oueds* in a few hours and carry with them devastation in Algeria and Morocco. The object of the Congress was to discuss methods of controlling this water and storing it so as to increase enormously the productive character of the soil, and it is probable that the suggestions put forward will be embodied in a programme of hydraulic works which will minimise the effects of drought over the greater part of North Africa.

High-Pressure Cables.—In an article on this subject published in "La Revue Générale de l'Electricité" for 24th December 1927, Mr. R. Fric, consulting engineer, reviews the phenomena due to the occlusion of gases in the dielectric of high-pressure cables, and considers the desirability of substituting some other gas for air in the course of manufacture. Experiments on this matter have been undertaken by the Compagnie de Signaux et d'Entreprises Electriques; the results are not yet available, but, after considering the properties of various gases, the author concludes that, whilst every effort should be made to eliminate gas-bubbles from the interior of a cable dielectric, it seems advisable to try to replace air by an inert gas having a dielectric strength and an ionisation potential as high as possible, so as to defer to the utmost the time when the phenomena of gaseous ionisation develop. The procedure proposed is as follows:—Before actually impregnating the cable, it is raised to the highest temperature short of injuring the paper, in a vacuum; the inert gas is then introduced, at atmospheric pressure or a higher pressure, into the vacuum chamber, for a sufficient length of time to replace the air removed by the evacuation. This cycle may be repeated, after which the vacuum is re-established and the hot impregnating material is allowed to flow in and cover the cable. It appears that preference is given to nitrogen as the substitute for air. The results obtained so far from the experiments are said to have given ground for hoping that the process will increase the reliability of high-pressure cables.

Energy Losses in Arc Furnaces for Steel Melting.—The Steel Works Committee of the Verein deutscher Eisenhüttenleute has been investigating the energy losses incurred in the melting and refining of steel in electric arc furnaces. The experiments were made in German and Austrian steel works, and the summary given by Mr. St. Kriz, in "Stahl und Eisen," of 19th January is based, not upon single runs, but upon a large number of runs made in different furnaces of the same type. It is found that about 40 per cent. of the electrical energy of the supply is wasted during the melting, and about 65 per cent. during the refining of the steel. Energy is lost in the supply, in the furnace, by radiation and conduction, and in the furnace gases. The component losses are estimated as follows:—The transformer (iron and copper) losses average 3 3 per cent. of the energy reaching the transformer; 6 per cent. of the energy leaving the transformer is lost in the cables; the cooling water of the electrodes carries away 4 (7) per cent. of the energy, the figure in the brackets referring to the refining period. The closed furnace loses 15 (29) per cent. through heat conduction and convection, mainly through the arches, and there are, in addition, radiation losses of 7 (11) per cent. through the open door and other openings. The heat losses from the walls increased as the furnace charge was raised from 4·5 to 8 tons, and the gases carry 4 (7) per cent. of the heat away. Thus 61 per cent. of the energy available is utilised during the melting process and 37 per cent. during the refining of the steel.

Southern Pacific Railway of Mexico.—According to the "Railway Gazette," a new route has become available from the United States to Mexico City by the recent completion of the Southern Pacific Railway of Mexico. The City of Mexico has by this new west-coast route been brought within 1,500 miles of the American frontier at Nogales, Arizona. The first portion of the new route was provided by the old Sonora railway, 265 miles long, from Nogales to the port of Guaymas on the west coast of Mexico. This was taken over by the Mexcian subsidiary of the Southern Pacific, which between 1905 and 1912 had completed over 670 miles of new route between Guaymas and Tepic, as well as a line at the southern end from La Quemada connecting with the National Railways of Mexico at Guadalajara. There remained a gap of 103 miles between Tepic and La Quemada to be filled in. The construction of this section offered the greatest difficulties, which have only recently been overcome by the completion of the line. Here the route has to ascend from the coast to the central plateau of Mexico, and many attempts were made in past years to secure a practical location. Revolutionary troubles between 1910 and 1920 also caused delay and great damage to the undertaking. Finally, in 1923, the new route was successfully located and construction begun. Many difficulties, both natural and political, had still to be encountered before the section could be completed in 1927. It contains a number of very steep gradients, with heavy excavation and tunnelling, there being, in the 103 miles, 31 tunnels aggregating about 25,000 feet in length, and 32 steel bridges, 20 feet to 860 feet long. The work was carried out by American engineers and contractors.

Turbine Locomotive Costs.—The subject of locomotive costs is interesting to all concerned with railways, and when comparisons are drawn by those in actual daily touch with the matter between the cost of operating the ordinary reciprocating type of steam locomotive and alternative types, the topic reaches one of its most important and interesting phases says the "Railway Gazette." Thus, in giving facts and figures relating to the cost of producing and running turbine locomotives, Mr. Gresley, in his Presidential Address to the Institution of Locomotive Engineers, provided some valuable data upon which to build clearer ideas upon the subject. He said that turbine locomotives so far produced suffered from the same disadvantage as the internal-combustion locomotive, *i. e.*, the high initial cost. It is claimed that a saving in coal consumption of from 20 to even 50 per cent. can be shown by the turbine engine, as compared with the reciprocating engine. A locomotive of the latter kind burns, approximately, 1,000 tons of coal per annum, and taking coal as costing £1 per ton on the tender, if a saving in coal consumption of 30 per cent. is assumed, it would represent £300 per annum. If the repairs to the turbine engine cost no more than those of the reciprocating type, and a provision of 3 per cent. were made for renewals, and 5 per cent. for interest on additional outlay, it would then appear that such a turbine locomotive cannot be regarded as attractive if it costs over £3,000 more than a modern reciprocating steam locomotive. Supposing a reciprocating locomotive cost £6,000, a turbo locomotive should, Mr. Gresley remarked, not cost more than £9,000, *i.e.*, an increase of 50 per cent. on the cost of the other. It has, however, to be proved that a fuel economy of 30 per cent. can be realised and maintained under all conditions of working, if the first cost is 50 per cent. higher, to make a turbine locomotive an attractive proposition.

General Articles.

FLEXIBLE PIPE JOINTS.

AN INTERESTING INSTALLATION IN THE UNITED STATES.

WE have previously given in these columns a description of the remarkable British invention known as the "Victaulic" flexible pipe joint, and we are able to reproduce herewith an interesting photograph of an application of a unique character. This relates to a swing-bridge in McKee Street, Houston, Texas, over which passes a natural gas pipe line at 50 lb. per square inch pressure, for the Houston Gas and Fuel Company, Limited. By using "Victaulic" joints, seen on the left of the photo on the opposite page, the bridge is closed and opened in a few minutes, the actual joint on the gas pipe being uncoupled in less than 60 seconds and made again in about 2 minutes, while also there is never any leakage at the joint due to the heavy vibration on the bridge caused by the traffic, the improvement in comparison with the use of an ordinary flanged joint with a series of nuts and bolts being obviously of a striking character.

The Victaulic Company, Limited, have just issued a new and much enlarged catalogue which we understand may be obtained free of charge on application to the firm's address, Dean Stanley Street, Millbank, Westminster, London, W. C. 1, and this contains a large amount of information on the flexible pipe joint in particular and pipe line engineering in general. Noteworthy is the fact that nearly all the outer housing rings are now made of steel alloy 22-24 tons tensile and 6 per cent. minimum elongation, a material unbreakable even with heavy blows from a sledge hammer, so that the worst conditions, such as underground in mining with subsidence and falls of roof or over wild and rough country, irrespective of water, shifting sands and other obstacles, can be withstood without difficulty. Special forged steel joints are however still supplied for installations such as rising mains and high-pressure oil pipe lines of large size.

The design of the "Victaulic" joint, it will be remembered, is essentially a heavy ring of high-grade rubber composition, bent over into the form of a flat inverted "U," contained in an outer housing ring, the pipes—steel, cast iron, wrought iron, galvanised or other material, including earthenware—having a small shoulder or rim at each end as made by any pipe maker. The encircling steel ring is then bolted round in such a manner that the lips of the rubber ring press down evenly all round the flat surface of the two shoulders or rims, and the greater the pressure the tighter becomes the joint without interfering with the flexibility.

The applications include water and many different solutions, such as sea water and sewage, compressed air in mining, crude oil, petrol, benzole, household gas, and natural gas, and in fact most liquids and gases other than steam, at all pressures between the very wide range of vacuum and over 4,000 lb. per square inch, including, of course, hydraulic power. Under these conditions an absolutely tight joint is obtained, while the flexibility is such that with the smaller diameter pipes each separate section of the mains can be shifted off the straight to an angle of from 1-5° in any plane. Further any length can be taken out and replaced without disturbing the rest of the line, the joint being also arranged so that it can be turned round on the pipe ends, while the time for making a joint is only a minute or two merely using a spanner.

With regard to use in tropical countries like India, one very interesting item is that a three years' test has been carried out on a "Victaulic" joint in Johannesburg in connection with prolonged exposure to the sun. This test was completed on the 9th June 1926, and there has been no sign of deterioration of the rubber ring within the outer housing ring, while also in South Africa the joint is now proved to be absolutely secure against white ants.

THE OLYMPIA MOTOR CYCLE SHOW IN RETROSPECT.

THE Thirteenth Olympia Cycle and Motor Cycle Show which closed on 5th November last was one of the most successful—if not the most successful—exhibition yet held if judged from the attendances and interest displayed by representatives of Continental and Overseas buyers. Public interest was well sustained, nearly 140,000 persons paying for admission which constitutes the second best attendance at any Exhibition promoted by the Manufacturers' Union.

The Exhibition was the ninth of the series held since the War at which there has been a total attendance by the public of nearly 1,000,000, whilst to this must be added the attendance of trade buyers to the extent of a further quarter of a million.

The number of exhibitors was well sustained in spite of the difficulties met by a large number of firms through the 1927 season.

As is now the rule the chief centre of attraction was the Ground Floor stands devoted to the exhibition of complete motor cycles, where a very large range of models from 147 cc. to 1,000 cc. where presented for inspection. A wide range of machines were offered for "Sports," "Utility" and "Commercial" purposes—a fact which gives the best possible evidence of the manner in which the use of motor cycles has broadened out amongst all social classes and to both sexes.

It could hardly have been imagined ten years ago that in the year of grace 1927 there would be at least 20,000 girls and women up to certainly 45 years of age who make habitual use of the motor cycle. To-day there are nurses and stenographers who use motor cycles as freely as do their more leisured sisters.

The lady saleswoman, the lady Trials' competitor and demonstrator has come to stay and has resulted in the opening up of a new profession for women.

The commercial motor cycle has developed remarkably since 1925 when the British Cycle and Motor Cycle Manufacturers' and Traders' Union, Limited, arranged the first Annual Demonstration of these vehicles through the north Midlands. Equally good work was accomplished in 1926 and 1927, and the best evidence of the value of the Demonstration was shown by the increased number of exhibits of the trade motor cycle combinations at the 1927 Show. Further, a dozen Motor Cycle Manufacturers have recently participated in the Collective Exhibit organised by the British Cycle and Motor Cycle Manufacturers' and Traders' Union, Limited, at the Olympia International Commercial Transport Exhibition, where the exhibit attracted much attention and favourable comment from the commercial vehicle trade Press and from the daily Press such as "The Times" and "Daily Telegraph."

An instructive pamphlet entitled "Carry by Sidecar" has been issued by the Manufacturers' Union abovementioned, which in clear and simple language states exactly the case for this economical, speedy and safe method of delivery of light loads not exceeding 5 cwts. It is not intended to convey the impression that for heavier loads anything but a four-wheeled van is suitable, but experience gained by a large number of distributors in the British Isles in the past three years has convinced them that a great deal of money is wasted by the use of unnecessarily large transport with its heavy consumption of petrol and oil in securing transportation of small and easily-handled loads.

The commercial sidecar—and three-wheeled cyclecar for that matter—are a perfect godsend to the small retail distributor owing to the light initial purchase price and the subsequent saving in running and operating costs. It is believed that there is a great future for this class of machine in Australia and in New Zealand and doubtless it is a direction in which the body builders in those Dominions will carefully look for further trade.

One of the chief attractions at the 1927 Olympia Cycle and Motor Cycle Show was the appearance of a purely British four-cylinder motor cycle, built by Mr. George Brough, of Nottingham, who is already

well known throughout the world of motor cycling as the producer of the now famous "Brough Superior."

It is said the original model on view cost £2,000 to produce, and be this as it may, it is certainly evidence of the care exercised in the construction of British motor cycles. Mr. Brough expresses himself as entirely satisfied with the progress already achieved and is assured that in every respect it will be a more than satisfactory competitor of similar American and Belgian types. He does not propose, however, to rest content with present results but has decided not to go into production of the model until the autumn of 1928 in order further to improve the already excellent results.

BRITISH ENGINEERING NOTES.

(By A Special Correspondent.)

London, *2nd February 1928.*

British Shipbuilding Progress in 1927.

A review of the world's shipbuilding industries in 1927 reveals the encouraging fact that greater progress was made by Great Britain than any other country. Notwithstanding the legacy of troubles left over from the disastrous industrial strife of 1926, the shipyards settled down to work off the arrears with the result that by the end of the year the nation's shipbuilding industry was once again in its old position of world leadership.

In the United Kingdom, there was a gain of 299 vessels over the 1926 production, the increased activity being noticeable in all the shipbuilding areas. On the Clyde, for instance, the advance was from 173 vessels of 286,350 tons to 274 vessels of 463,528 tons.

Among the largest vessels launched during the year was the Canadian Pacific Railway Company's twin-screw turbine liner "Duchess of Atholl," of 21,500 tons and 18,500 h.-p., built by Beardmore and Co. at Dalmuir. This fine addition to the Atlantic route is some 600 feet in length and has a service speed of about 17½ knots. There is accommodation for 600 cabin passengers and 1,000 third class passengers.

It is interesting to recall that Beardmore had an early connection with the C. P. R. through the Allan Line, for which they built the "Parisian" and the "Alsatian" (now the "Empress of France").

An Addition to the White Star Fleet.

The total production of Harland and Wolff's yards at Belfast, Glasgow, and Greenock last year was 49 vessels of 94,700 tons, a fine example being the "Laurentic," built for the White Star Line. This ship will run on the company's Canadian service and has accommodation for 1,600 passengers, cabin, tourist and third class. She is 18,724 tons of the triple-screw type with turbine and reciprocating engines giving 13,000 h.-p.

The "Laurentic" affords a good example of the excellent accommodation now available to the third class traveller on the best vessels. In addition to well furnished state rooms for four and six persons, there are a number of two berth rooms, fitted with hot and cold water, available for married couples and friends travelling together. A large number of powerful "Sirocco" fans, made by Davidson and Co. of Belfast, ensure that the ventilation system is in keeping with the general high standard of the ship.

New Naval Vessels.

Last year saw, too, considerable activity in the field of naval work, a feature being the order for six destroyers for Chile, secured by Thornycrofts in the face of very keen competition. The value of this order is about £1,750,000, and it means employment for some 2,000 men in Southampton alone over a period of about two years.

The first of the fleet, the "Serrano" was launched quite recently, and it is possible to give a few details. The length is 300 feet, displacement, fully loaded, about 1,430 tons, and contract speed 35 knots. The main armament consists of three 4·7-inch Q. F. guns and six 21-inch torpedo tubes. The arrangement of the machinery is very similar to that of the "Amazon" which the same firm recently built for the British Navy.

Three more of the six destroyers were at the time of the launching in various stages of construction, while work on the keel of the fifth began within an hour of the launching ceremony in the berth vacated by the "Serrano."

Marine Motoring More Popular.

The motor boat industry made considerable headway last year compared with the years immediately preceding it, and, with public interest aroused in many parts of the world, the prospects for the future are distinctly encouraging.

New models, reduced prices, improved equipments are all signs of a progressive policy and one which will go far towards popularising the healthy sport of marine motoring. Thus, the range of Ailsa Craig engines for the current year has been augmented, while new features, the outcome of practical experience in all parts of the world, have been incorporated. The range now extends from the Ailsa Craig "Pup" with a 4—6 h.-p. twin-opposed motor to a 100 h.-p. model. It includes the smallest British built 4-cylinder unit, the "Silent Seven" of 7—12 h.-p., which is produced at the home price of £72, complete with reverse gear and clutch. It can no longer be said with truth that motor boating is only a rich man's pastime, for there are now engines and complete boats to suit almost every purse and a wide variety of types for pleasure and pure utility.

Londoners had almost an unique opportunity of watching a speed boat in action not long ago when a new Thornycroft 55 feet coastal motor boat underwent a trial in the Thames and was timed over a straight mile at 39 knots. From Westminster the course taken was under London Bridge and through the Pool, a very busy reach of the river.

The vessel was the first of two ordered by the Dutch Government for service in the East, and carries two 18-inch torpedoes, Lewis guns and two depth charges, as well as wireless equipment. The two main Thornycroft engines, of 12 cylinders each, develop 400 h.-p. and are for high-speed work, another engine being employed for cruising.

Since the war, in which of course the "C. M. B.'s" made a great name for themselves, orders have been received from some six foreign governments including France, U. S. A. and Japan.

The Progress of the Diesel Engine.

A number of outstanding vessels with internal combustion engines were put into service during the year; the 19,000-ton luxury ship "Bermuda," for instance, launched in June, and the first passenger vessel fitted with opposed-piston machinery. Her main purpose is to carry passengers during the season between New York and Bermuda, doing world cruises for the remainder of the year.

Of popular interest is the motorship "Itapé," the first of three vessels being built by Beardmores for the Companhia Nacional de Navegacao Costeira, of Rio de Janeiro. The engines are supercharged and are the first supercharged Diesel engines to be put into a British-built ship. The main propelling machinery, built at Dalmuir, consists of two Beardmore-Tosi 4-stroke cycle single acting Diesel engines, developing a total of 3,600 b. h.-p. when supercharged. On trial in the Firth of Clyde last November the "Itapé's" machinery ran with great smoothness.

Beardmores have, of course, been prominent in the development and manufacture of high-speed oil engines up to over 1,000 b. h.-p. for locomotive drive with electric transmission. Excellent results have been obtained with these units with remarkable fuel consumption.

Diesel engines are certainly making headway in a number of new directions on land where the question of the storage and handling of fuel is a consideration. Thus, John Fowler and Co., of Leeds, are employing engines of this type in some cases for ploughing and cultivating work. As against steam engines, the Diesel enjoys the advantage of not requiring a constant supply of water to keep it at work.

Fowlers have found the internal combustion engine very suitable for use with shunting locos. and they are producing a 40 h.-p. loco of this type which has given most convincing results under test. It combines the strength and durability of a steam locomotive with the advantages of an internal combustion engine for intermittent work.

A Petrol Driven Industrial Truck.

A comparatively new comer is the petrol driven industrial truck which is now being used by many of the leading railway companies and large concerns for some of their transport requirements. This will undoubtedly be examined with interest at the Birmingham section of the British Industries Fair, in the form of the Lister Auto-Truck, manufactured by the well-known Gloucestershire firm of R. A. Lister and Co. Driven by a petrol engine, it can be used continuously night and day if desired, as there are no delays for battery charging.

It is built to carry one ton and is particularly handy to manœuvre in confined spaces as it can be completely turned in a radius less than its own length. A variety of bodies can be fitted to this efficient vehicle to suit the special requirements of any particular trade.

Generating Current at Low Cost.

The largest stationary oil engine built by a British firm is the 1,750 b. h.-p. 6-cylinder Fraser and Chalmers unit, recently installed in one of the London generating stations, and coupled to a 1,200 kw. direct-current generator. The many interesting features embodied in its design have resulted in remarkable fuel economy and low maintenance costs. For instance with fuel at £4 per ton, and a load factor of 70 per cent., it is possible to generate current at the extremely low figure of just under a halfpenny per unit, this including lubricating oil, wages and repairs.

The reason for this low cost is due to the design of the engine which possesses features ensuring a high thermal efficiency, namely, 35·5 per cent. on the b. h.-p. basis and 46 per cent. on the i. h.-p. basis. In other words, the amount of fuel doing useful work is 35·5 per cent. of that put in, the remaining losses going in exhaust gases, cooling water and radiation. In comparison, the best average for a steam plant of 5,000 kw. and over is about 18 per cent. below this output, the efficiency is about 15 per cent.

Locomotive Building Activity.

There was a considerable increase in activity among British locomotive builders last year and a substantial number of orders have been booked quite recently for Overseas.

At the present time the official trials of the Kitson-Still locomotive are being awaited with very great interest, as this embodies for the first time the Still engine principle as applied to locomotive practice and the results may quite well mean revolutionary changes in future design.

During last year the demand for Sentinel-Cammell rail coaches continued to expand and among the Overseas countries supplied were India, Ceylon, Iraq, Salvador and South America. The British railways also took a number into service.

Among orders now in hand, 20 coaches are under construction for the London and North Eastern Railway and four double cars for the Ceylon Government Railways, the latter to seat one and thirty passengers.

THE KENNEDY FORMULA.

I.

THE substance of these articles had been ready for some time, when it was pointed out to the writer that there was a little difficulty in grasping the issues with his factorized notation. Unfortunately, the whole Pyramid Theory depends on *f*, which means factorization. The writer has therefore decided to split the articles up under three heads, the first being "Factorization," in the three articles already published. The procedure is in the nature of putting a cart before the horse; but if it brings the subject more clearly before the reader, the writer sees no logical objection worth considering.

The References are Volumes CXIX and 223 of the Minutes of Proceedings of the Civil Engineers: Mr. Kennedy's paper on "The Prevention of Silting in Irrigation Canals," and Mr. Griffiths' paper on "A Theory of Silt and Scour." Both papers must be taken as read.

Above all things Mr. Kennedy was a practical working engineer; and the efforts of such engineers are very properly directed towards the simplification of formulæ. Anybody who has had to deal with complicated formulæ, involving the working of long and troublesome calculations, is aware, by bitter experience, how much they bemuse the brain and cloud clear thinking. The empiric formula has much to answer for; not the least evil it does is the *smothering* of intellect, the drugging of the spirit of enquiry.

The efforts of this practical engineer were directed towards extreme simplification, by the elimination of the hydraulic mean radius and the slope or inclination of channel, both factors very difficult to determine with the necessary exactitude in a running canal. The object sought was V_o, from the depth d only. Mr. Kennedy found, in certain sections of canal which he had studied with keen observation and the utmost care, that in each a certain continuous velocity of flow at a reasonably constant water-level resulted in what might be called a "Kennedy Section," quite stable as long as that velocity was maintained, neither further silting nor scour being detected. Upon these observations, and for these particular sections, he based his famous formula, $V_o = 0{\cdot}84\, d^{\cdot 64}$; and suggested that by similar close observation it ought to be possible to devise similar formulæ for other localities and different conditions of flow. The work done was invaluable, since it opened the eyes of all irrigation engineers to the practicability of devising a scientific determination in every part of the world of the appropriate critical mean velocities. Mr. Kennedy's work encouraged other engineers to seek a LAW. In the circumstances, the name of Kennedy is inseparable from V_o, however determined; and this consideration has decided the writer to name the Formula published in INDIAN ENGINEERING, the Pyramid Kennedy or P. K. Formula. The name of Kennedy ought to be, and must be, perpetuated.

Kennedy's formula may be written :—

$$V_o = C_o \sqrt{m_o}$$

a variation of $v = c \tan \theta$, making $C_o = c \div l^{\frac{1}{2}}$ or $v \div m_o^{\frac{1}{2}}$. It will be seen that the P. K. equation

$V_o = C_o \sqrt{m_p}$ both leads and follows in natural sequence.

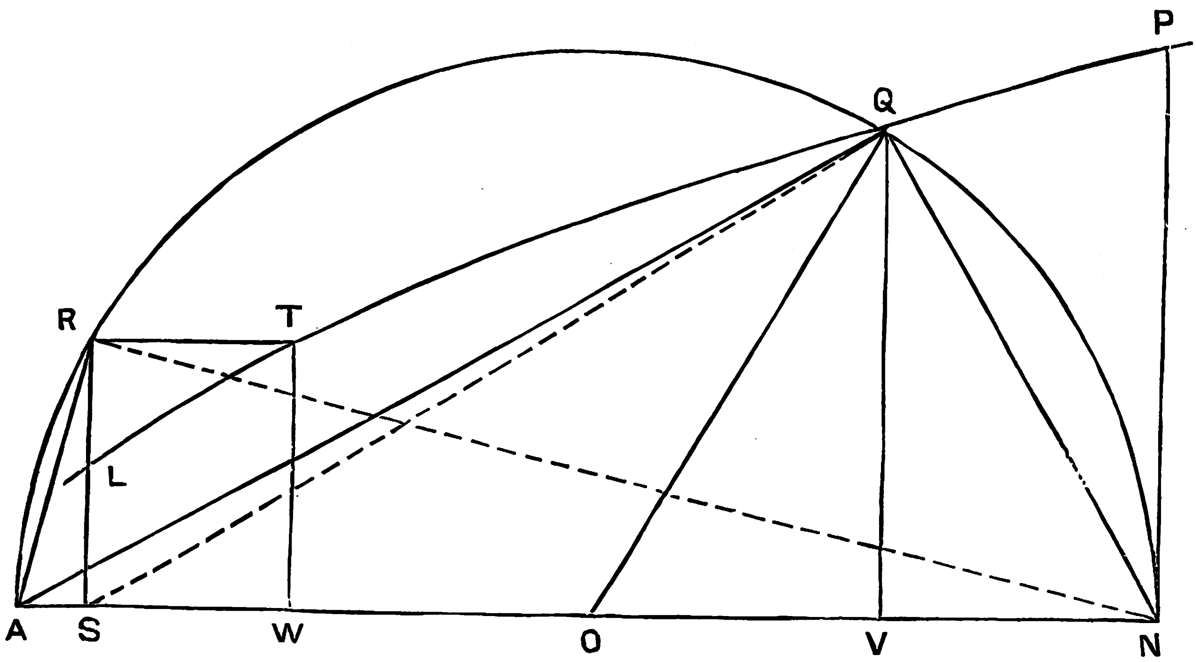
In the figure below :—

Let $AS = a^2$; and $AN = b^2$.

$AR = ab.$

$NP = 2ab.$

$AW = \frac{1}{4}(b^2 - a^2).$



Draw a parabola ALTQP with vertex A and focus S, and let SL be the semi-latus rectum. Bisect AN at O, and draw the semi-circle ARQN, cutting SL produced in R and the curve of the parabola in Q. Draw RT parallel to AN to intersect the parabola in T, drop the perpendiculars TW and QV, and complete the figure as above by joining points.

Wherever N is placed on AN, and the corresponding semi-circle described, the triangle OQN is an isosceles triangle; and ARN and AQN are both right-angles.

Let, in Kennedy's formula, $V_o = C_K d^z$, AS = $\frac{1}{4} C_K^2$ and AN $\doteq d^{2z}$, then NP = V_o, for any values assigned.

Following previous procedure :—

$$AS = 1 ;\ AN = 16 ;\ SL = 2.$$
$$AO = OQ = ON = 8.$$
$$SR = \sqrt{SN} = \sqrt{15} ;\ SO = 7.$$
$$AW = \tfrac{1}{4}\ SN.$$
$$NP = QN = 8.$$
$$OV = VN = AR = 4.$$
$$VQ = 4\sqrt{3}.$$

In this particular case the triangle OQN is equilateral and the angle QAN = 30°.

The problem before the engineer is: Should the hydraulic mean radius be employed in preference to the greatest depth d?

Σ. Φ.

14th November 1927—
1st January 1928.

ON SIX-WHEELERS IN GENERAL.

THE extraordinary growth of road transport in the last few years has led to a complete revision of preconceived ideas. And, as a result, it has been incumbent upon manufacturers of transport vehicles entirely to reconsider their previous designs.

Hence the rigid six-wheeler.

The earliest attempts at building a six-wheeled vehicle consisted in telescoping a waggon and trailer into a single unit with the suppression of one pair of wheels. But although this might be regarded as an evolutionary step, the articulated six-wheeler, as it came to be known, was never more than a makeshift; a vehicle with such definite limitations as regards speed, safety and manœuvring capacity that it could never possibly become the prototype of a new class.

The difficulty in the way of designing a proper six-wheeled vehicle was more imaginary than real. It was argued that whilst it was possible to steer a four-wheeled vehicle around relatively small arcs and maintain all four wheels in rolling contact with the road, this could not be done if the number of axles were increased to three, unless the vehicle were articulated, or unless two of the axles were steerably mounted. It was only when it was realised that the wheels of a vehicle proceeding along a road are never in perfect rolling contact with that road, but that rather the vehicle proceeds in a series of hops, more or less pronounced according to the road surface and the machine's speed, that the conception of the modern rigid six-wheeler became feasible.

It was then seen that if the rear wheels were placed as close together as possible so that there would be very little difference in the position of the arcs described by each axle when the vehicle turned, the fact that there was only partial rolling contact would allow of the slight necessary lateral displacement of the tyres which must take place when the vehicle turned.

Practice has abundantly proved that this theory is correct. Many hundreds of rigid six-wheelers have now been built and are in service—some for as long as two or three years—and the predicted excessive tyre wear has not taken place. On the contrary the tyres have actually shown a bigger mileage, in proportion to the weight carried, than those on four-wheeled vehicles. The reason for this is one of the interesting things that was discovered as a result of practical experience with this type of vehicle.

Owing to the "hopping" progress of a vehicle along the road, the differential mechanism, provided between the driving wheels on either side of the vehicle, is constantly in motion. The extent of this movement is almost unbelievable until one tests the matter out by means of two speedometers, one connected direct to the road wheels and the other to some part of the engine ahead of the differential. A noticeable difference in the readings of these instruments will be found in a few yards of progress. At the end of a day it amounts to a matter of miles, and in a year many hundreds of miles.

What actually happens is that every time one of the wheels loses its adhesion, momentarily, it is spun a portion of a revolution by the engine operating through the differential mechanism. When the wheel comes down on the ground this excessive speed must be checked by the friction of the tyre on the ground, and this, taking place continuously, makes an appreciable difference in the wear of the tyres, whilst the wasted engine revolutions show equally in the annual fuel bill.

On the other hand, in a properly designed rigid six-wheeler with a fully compensated bogie, where one wheel can only leave the ground when the other wheel on the same side is pressed firmly into contact with

it, and where all four of the wheels are positively driven from the engine, there must always be at least two wheels in contact with the road on opposite sides of the vehicle, and therefore this wheel spin can never take place; with a net result of a considerable lessening in tyre wear and a very considerable diminution in the cost of fuel.

The practical proof that this is correct lies in the fact that if a differential mechanism be incorporated in the drive between the two axles, these advantages immediately disappear.

It will be seen that in order to obtain the full benefit of the rigid six-wheel type all four wheels must be carried on proper compensating bogies and all four wheels must be positively driven. Thus the futility of designing a rigid six-wheeled vehicle and only driving one pair of wheels is at once apparent. Also merely to hang an extra pair of wheels under the rear portion of a four-wheeler is equally purposeless, unless the bogies are so arranged as to act in a compensating manner.

In the latest rigid six-wheeler, as exemplified by the "Sentinel," all these advantages are most fully maintained, whilst at the same time greater simplicity in the driving mechanism has been achieved than heretofore. Add to this an entirely new design of engine capable of giving greater power for less fuel than any previous "Sentinel" engine produced, and incorporating a two-speed or emergency gear; the ability to turn in a circle not larger than that required by a "Super Sentinel" four-wheeled vehicle; a road carrying capacity of 12 to 15 tons on first-class British roads and ruggedness of construction, coupled with astonishingly small unladen weight, and you will have the reason why this new vehicle has created the greatest stir in transport cicles, and why those competent to judge who have been able to see the vehicle and its performance are unanimous in expressing the opinion that it marks a definite epoch of mechanical road transport progress.

The manufacturers, who realise that the roads in Overseas countries are not in every case suitable for a vehicle with such a heavy load as their new six-wheeler has been designed to carry on the roads in the British Isles, have under consideration a six-wheeled waggon of a similar design, but adapted for carrying from 8 to 10 tons. This should prove of particular value to users of steam vehicles in countries Overseas.

BACK BAY SCANDALS.

(BY A CORRESPONDENT.)

NOTICE has been given of a resolution to be moved in the forthcoming session of the Bombay Council, recommending Government, who have already been advised to relieve Mr. Harvey of part of the expense he brought on himself in prosecuting Mr. Nariman for defamation, to sanction the payment of a substantial amount to the defendant to enable him to meet the heavy cost he has had to incur in defending himself and incidentally in rendering splendid service to Government and the public in "exposing the affairs of the Development Department." If the advice of the Advocate-General to help Mr. Harvey is followed, it will be comparatively easy to accept and act on that of Mr. Jadhav for compensating Mr. Nariman. Many think there should be no difficulty in obtaining sanction for the grant of an unsolicited reward in gratitude for meritorious service rendered to the State. There is still much left for him to do in the way of stable-cleaning which has been started. Employing and helping him to complete the unravelment of the complicated system of bribery and corruption, would be a suitable way to show appreciation and gratitude as well as to obtain the best results. He has raised the curtain sufficiently to let the public see some of the unclean things lurking in the precincts of a large spending department. The natural wish is to drag these out into the open for closer examination. Concealment at this stage will be worse than useless. It is too late and it is out of date, as far as Bombay is concerned at least, to continue the "purdah system" of carrying out public works, while there must be few who, wanting healthy development in State affairs, believe in the sort of official secrecy that is at the bottom of much of the immunity from detection that has been enjoyed by dishonest employees. It is moreover a system in which plain facts, innocent in themselves and taken apart from conclusions that may be affected to be derived from them, become suspect only because of the label "for official use only" under which they are hidden away, when they would be perfectly harmless, perhaps unnoticed even, if published without hesitation or given immediately when asked for, as used to be the case not many years ago. Hidden away or withheld, they are liable to leak out through unauthentic channels and perhaps to take on coloured and garbled form, unfavourable to the department concerned which is then immediately accused of manipulating facts with a view to evading perplexity and trouble involved in following a straightforward course. Then explanations and excuses for unsatisfactory conditions and results often have their origin with officials who, for various reasons, elect to work behind closed shutters, and it is frequently assumed that such places are unhealthy and require more light and air.

The Gazettes.

Punjab, February 24, 1928.

Buildings and Roads Branch.

On transfer from the Ferozepore Provincial Division, which he left on 21st January 1928, Lala Dwarka Parshad, Nayar, Assistant Engineer on probation joined the Gurgaon Subdivision of the Gurgaon Provincial Division, on 30th January 1928, and took over charge of the Subdivision, on 3rd February 1928, from Lala Diwan Chand, Sharma, Apprentice Engineer.

Mr. Ram Chand. Kinra, who has been appointed a Temporary Assistant Engineer, reported his arrival at the office of the Superintending Engineer, Third Circle, on 1st February 1928, and assumed charge of his duties as Personal Assistant to the Superintending Engineer from that date.

On transfer from the Dera Ghazi Khan Subdivision of the Multan Provincial Division, which he left on 5th December 1927, Lala Harbhagwan, Temporary Assistant Engineer, joined the Montgomery Subdivision of the Montgomery Provincial Division on 7th December 1927, and took over charge of the Subdivision on the same date from Mr. H. A. Harris, Assistant Executive Engineer, transferred.

Irrigation Branch.

Mr. E. N. Fenwick, Executive Engineer, attached to the Public Works Department, Punjab, Irrigation Branch, is allowed by the High Commissioner for India, leave on half average pay on medical certificate for three months in extension of the leave granted to him previously.

Mr. N. G. Watson, Temporary Engineer, attached to the Public Works Department, Punjab, Irrigation Branch, is allowed by the High Commissioner for India, three months' leave on half average pay on medical certificate, in extension of the leave granted to him previously.

Mr. W. J. Benson, Assistant Executive Engineer, on transfer from the Central Workshops Division, Amritsar, which he left on 12th January 1928, joined the Majitha Division, Upper Bari Doab Canal, on the 20th idem.

Mr. F. J. Waller, Superintending Engineer, 3rd Bahawalpur Circle, Sutlej Valley Project, is allowed leave on average pay for 7 months from 1st April 1928, or subsequent date.

Mr. R. K. Nariman, Executive Engineer, attached to the Rasul Division, Lower Jhelum Canal, is allowed leave on average pay for 6 months and 3 days and in continuation leave on half average pay for 28 days from 15th April 1928, or subsequent date.

Lala Ram Sarup, Assistant Executive Engineer, on transfer from the Panjnad Weir Division, 3rd Bahawalpur Circle, Sutlej Valley Project, which he left on 10th January 1928, took over charge of the Khanewal Division, Lower Bari Doab Canal, on the 11th idem from Mr. W. F. Smith, officiating Executive Engineer.

Sheikh Muhammad Sharif, Assistant Executive Engineer, on transfer from the Lower Gugera Division, Lower Chenab East Circle, which he left on 16th January 1928, joined the Burala Division, Lower Chenab East Circle, on the 24th idem.

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INDIAN ENGINEERING.

SATURDAY, MARCH 10, 1928.

MR. C. G. PALMER, C. I. E.

III.

MR. PALMER, one of the best of *raconteurs*, had many stories of famine incidents, most of them of sombre hue, but one which was not without its humorous side seems worth the telling. On a road embankment under construction, he came upon a group in hot argument, with workers around grinning in furtive glee. A harassed "officer-in-charge" (a naib-tahsildar) faced an angry woman of stout build and a wizened man who clutched two newly-born infants in his arms. The troubled officer explained: "We give two rupees for 'medical comforts' to any woman who has a baby on our works. This woman has borne twins The reward given by the Government is two rupees, she says that she must have double reward." The woman broke in with: "For one baby two rupees, two babies four rupees, justice should be done." The husband croaked: "Hau, hau," and waved the two babies in the air to add to the weight of the evidence. Mr. Palmer decided in favour of the woman. The officer protested: "But, Sir, if that interpretation is maintained, all the women of the countryside will come on our works and have twins to the great loss of the Sarkar." Mr. Palmer said with becoming gravity: "Now, tahsildar-sahib, listen to me. You think our relief works tend to fertility of population. Consider the boon to childless couples, and, on the other hand, those who have already large families will keep their women off the works and the Government will be the gainer by it." So the woman got her four rupees for medical comforts and marched off with the glad light of victory in her face. The husband shambled after her with two brown objects clasped to his lean stomach, a look of fatuous admiration for his spouse on his countenance. The workers returned to their labours, shaking their heads and muttering that Palmer Sahib knew something about *insaf.* The Government was not ruined. There was an atmosphere of rosy thoughts and peace and happiness at the cost of two rupees; and for the moment everyone forgot that grim famine stalked across the land.

On the closure of the relief works, Mr. Palmer assumed charge of one of the Irrigation Circles, and in 1899 was appointed to officiate as Chief Engineer and Secretary to Government, a post in which he was subsequently confirmed. In 1901 he became a member of the Legislative Council, and on the 15th October 1902 he retired from the service of Government. The only new project during the period of his Chief-Engineership was the Ken Canal, a protective irrigation work for Bundelkhund of some importance, which was submitted and started in his time. The Resolution of H. H. the Lieutenant-Governor on the annual Irrigation Branch Report of 1902 said: "This report is the last which will be written by Mr. C. G. Palmer, C. I. E., Chief Engineer, who in the next few days will retire from the service. The services of Mr. Palmer,

especially during the strain and stress of the famine years, have often been recognised by this Government, and the Lieutenant-Governor now desires to thank him for his administration, to congratulate him on the high state of efficiency in which he leaves the Department over which he has presided since 1899, and to wish him personally all happiness and prosperity."

With this very pleasant send-off, Mr. Palmer retired to England, and shortly afterwards worked on the organisation to promote Lord Roberts' scheme for a body of trained men to feed the Army in the event of war. In later years, people remembered that Lord Roberts had said in one of his speeches: "Now, just as in 1866 and 1870, war will take place the instant the German forces by land and sea are, by their superiority at every point, as certain of victory as anything in human calculation can be made certain. Germany strikes when Germany's hour has struck. That is the time-honoured policy of her Foreign Office. It is her policy at the present hour. It is, or should be, the policy of every nation prepared to play a part in history. Therefore, arm and prepare to quit yourselves like men, for the time of your ordeal is at hand." But accurate as Lord Roberts was in his prophetic utterances, he was not believed, and war was regarded as impossible and unthinkable. The organisation Mr. Palmer had joined came to nothing, and in 1910 he decided to go to Vancouver Island and see whether it would suit him to settle there. It did suit him, and he went in for farming on a small scale. In 1913 he was invited to join a Co-operative Creamery, and re-elected to the directorate year by year, he saw it through the difficult years of war, finally retiring in 1919. In 1914 he was elected to the Municipal Council, and served on that also throughout the war years. In 1915 he was appointed a member of the Board of Police Commissioners, from which he only retired comparatively recently. In 1916 the Co-operative Creamery approached the matter of a general organisation of farmers and Mr. Palmer took a prominent part in the proceedings. A little later, at a meeting of over 200 farmers in Victoria, the "United Farmers of British Columbia" had its birth, and at the end of the meeting Mr. Palmer was unanimously elected as the first President of the Association, a position he occupied for a year and then declined re-election.

It is not surprising that Mr. Palmer's good offices should have been sought in British Columbia, even though he found himself there in new surroundings at an advanced age and after a full service as an engineer in India. Wherever he had been in the course of his career, as a small boy in the siege of Lucknow, as an irrigation engineer, as a brick manufacturer in Australia, as a famine officer in a bad famine, and as the administrative head of a department, he had given a good account of himself. There was that something in him which made him effective. He had a good business head, unfailing common-sense, and a way of working in amicable accord with all sorts and conditions of men which was always a valuable asset to him. Personality, it has been said, is everything in the East, but as a matter of fact it is pretty well everything everywhere. It is a better possession than great theoretical attainments or the higher mathematics. The manner in which a man of happy personality will say the right word at the right time and pen a letter that will have exactly the right effect on its recipient will carry him further than the gifted brains of caustic individuals in sailing across the troubled waters of the world. Mr. Palmer had that form of personality, he had his opinions, but he also had the knack of making them carry weight, and to that may be attributed much of the success as the happiness of his life. He celebrated his eightieth birthday last October, and though it is a little late we offer our congratulations on that anniversary, and wish him the best of good wishes for his remaining years.

IRRIGATION IN EGYPT.

A PUBLICATION issued by the Ministry of Public Works, Egypt, entitled "The Irrigation Service, its Organisation and Administration," by Mr. P. M Tottenham, C. B. E., Chief Inspecting Engineer to the Egyptian Government, is an excellent account of the methods and work of the Irrigation Service in Egypt and a very useful booklet of reference for those who need information on the subject.

Egypt, practically a rainless country, depends for its prosperity on the waters of the Nile, a river which derives its supplies from the heavy rains of the regions to the south. Without the Nile, Egypt would be a desert tract, but it is a country of an ancient civilisation and it must have owed its wealth to the practice of irrigation from very early days. The publication says that particulars as to how the art of irrigation was practised in the time of the Pharaohs are wanting, but from the recorded information at the period when Napoleon sent scientists to Egypt it is known that the country was irrigated by inundation on the basin system, and it may be assumed that this was the traditional system of a great number of centuries. The Nile carried great floods of water to Egypt, the water in flood seasons carried much fertile silt in suspension, the silt enriched the soil, and the sun did the rest. Considering the ancient prosperity of the country, there is every reason to suppose that in those old days there was competent native engineering talent and a Government which employed it to good effect. The prosperity decreased when the administration was no longer efficient; and if the French engineers of their particular period failed to achieve very much, it was not their fault, they had no executive powers and could do no more than advise. Lieutenant-Colonel Ross, in the introduction to the 1889 edition of Willcocks' "Egyptian Irrigation," said that up to 1882 irrigation in Egypt was going down-hill year by year, and it was not till the days of British occupation, when Sir Colin Scott-Moncrieff imported from India Ross, Brown, Willcocks, Foster and Garstin, as engineers to assist him in arresting the chaotic state of affairs, that the great change came. It was a tremendous change, the five engineers who were the pioneers in the enterprise were first-rate men, and there were other engineers from India who also made their mark, men like Colonel Western, A. G. Reid and Arthur

Webb. And it was not merely that the engineers were so competent, they had, what their predecessors the French engineers had not, the powers to direct operations and the support of the administrative authorities. The benefits to Egypt due to the forty years of British occupation, it would be almost impossible to exaggerate.

Still, there is a danger. Sir John Russell, F. R. S., has recently called very strong attention to the soil deterioration in Egypt, following on what he called "modern irrigation." He said that there was no evidence of like deterioration on land irrigated by the old basin or inundation method; he said that Egypt is not the only country affected, all modern irrigation projects are liable to this deterioration; and he pleaded for an extended investigation into what he believed to be one of the most serious agricultural problems confronting the Empire. The views of Sir John Russell are entitled to every respect, but more important are the opinions of Sir William Willcocks, an eminent engineer who has studied that particular aspect of irrigation more than any other irrigation expert has done. He knows the havoc which high-level perennial irrigation has made of lands which had been rich, and he said in one of his lectures that "the true solution of this problem of reclamation lies in a return to the basin system." He said that "it must be possible to restore this land to the fertility it possessed under the Pharaohs, who were acquainted with no arts which we do not possess, but under whom what is now a desert was a garden." He said also that with perennial irrigation supplanting basin irrigation, and weirs and obstructions multiplying on the Nile, it was a case of imitating the ancient Chaldeans on the Tigris and Euphrates, and of having to learn by bitter experience what injudicious perennial irrigation can do to ruin a country whose formation is deltaic and therefore capable of being ruined. With warnings such as these in front of them, irrigation engineers in India might well give themselves pause to reflect. It is not so very long ago that some of them, in their ignorance, thought it amusing to accuse their senior brethren in the profession of holding the view that inundation canals were the last word in efficiency. The senior engineers never said that inundation irrigation was the last word in irrigation science or anything else that would justify the accusation; but they knew, as Sir William Willcocks knows, that there are tracts where an over-abundant supply of perennial water will assuredly do a very great deal of harm. In the Panjab the subterranean water table is in level far below the level of the *bangar* land in the doabs, but even in the Panjab waterlogging has become serious on some canals where the evil was not anticipated, and for the latest project to give perennial irrigation to a *khadar* tract, like the Nili Bar, would not appear to be wise. The tract is Government waste and has to be colonised. In such situations, India has not unseldom been handicapped by the lust of the cultivators for immediate profit without any regard for the future, and whatever the precautions taken to prevent too high an intensity of irrigation in the above Bar there is much reason to fear the occurrence of those evils which the Panjab is seeking to arrest. In Sind the menace is worse, and if the Sukkur Project succeeds in irrigating the very extensive *rabi* area contemplated, the consequences may be lamentable. It would be a curious irony of fate if, after what has been said about perennial irrigation by the authors of the post-war projects, inundation irrigation had to be re-introduced in order to reclaim lands thrown out of cultivation by the disastrous effects of perennial water in a deltaic country.

To revert, however, to Mr. Tottenham's blue-book, perennial irrigation in Egypt is of comparatively recent introduction, and the area under it now much exceeds the basin area. The total area of Egyptian territory is about a million square kilometres. Of this, about one-thirtieth is cultivable. The cultivated area is 5,300,000 feddans, and about 4,000,000 feddans are perennially irrigated, the remainder, about 1,300,000 feddans receive flood irrigation. Regarding the latter, the flood waters are led into the 212 basins of areas varying from 370 to 75,400 feddans. The basins are surrounded by banks, and the banks are pierced with regulators to pass the water from basin to basin, the bank of the tail basin being pierced with an escape which discharges the water when the basin, or chain of basins, is due to be emptied. On the muddy surface of these basin areas the crops are cultivated. Mr. Tottenham describes the irrigation systems of Middle and Lower Egypt and of the Sudan, the administration of the Irrigation Service, the duties of the officers, and gives much other information of interest to canal engineers in India in a very readable form.

ROADS, ANCIENT AND MODERN.*

THERE is much romance in engineering, and to that road-engineering is no exception, inasmuch as the road is one of the great fundamental institutions of mankind, so fundamental that people are liable to forget that it ever had an origin. It was about three years ago that Mr. Hilaire Belloc, who can write charmingly about anything and everything, had a book on "The Road," in which he discoursed on the history, theory and principles of road-making, and other things that every road-engineer ought to know. And now there is another book on "The Story of the Roads," which is also worth reading. It does not matter that it is the story of roads in the United Kingdom, for almost any sort of engineering in any country has something of value to convey. The romance of the road has always something in it of the romance of history, Mr. Belloc remarked that the material rise and decline of a State are better measured by the conditions of its roads than by any other criterion, and that is a fact to remember now that all civilised countries are at a turning-point in the history of the highway of very great significance.

In the earliest days of Britain there were no roads there were only tracks, and it was not till the coming of the Romans that the first vital change occurred.

* The Story of the Roads, by Cyril Hughes Hartmann. M. A., B. Litt., London, George Routledge and Sons, Ltd., Broadway House, Carter Lane, E. C.

The Romans were great engineers, and Mr. Hartmann says that the roads during their centuries of occupation were superior, not merely to anything before their time, but to anything since right up to the beginning of the nineteenth century. In fact, they anticipated the theories of the two great Scotsmen, Telford and Macadam. The best of the Roman roads were of very solid construction, they had five layers, the pavimentum, statumen, ruderatio, nucleus and summum dorsum, and they were so strong that in the circumstances of the traffic of that time they lasted for long periods without the need of repair. But, subsequent to the Roman occupation, the condition of the roads became deplorable, travelling was difficult, and by reason of robbers and marauders also dangerous. Bridges have always followed roads, in early times they were rarely built simultaneously with roads, the Romans built some bridges, but otherwise rivers were crossed by fords and water-splashes, though occasionally a bridge might have been erected, as in India, as an act of piety. A sick man of substance might provide the funds for a structure for the public good, and hope by that pious act to regain health. Benefactions of this nature were not altogether uncommon in the West or East. Until the fourteenth century, wayfarers travelled on horseback or on foot, wheeled carriages were introduced after the Crusades, but their use was confined to the high and mighty in the land. Carriage of goods was by pack-horses, and as the need for transport increased, the inland trade was conducted as far as possible by water. For centuries the rivers were England's main roads. As far as roads were concerned things went from bad to worse, and by the beginning of the sixteenth century roads were at their worst. They improved a little in the reign of Queen Elizabeth, because a developing England was beginning to assert herself, but progress was very slow, and it was slow because there was always a want of money. It was not till the seventeenth century that for the purpose of raising funds the first Turnpike Act was passed. The principle of turnpikes was that the users of roads should pay for their upkeep, and wheeled traffic being so greatly on the increase it was perhaps the best system that could be devised. The position was similar to that of India of going on for three centuries later, the structure of vehicles had to be adapted to bad roads, instead of roads keeping pace with the vehicles, and the roads with their jolting, uneven surfaces were not any the better for being infested by footpads and highwaymen. The eighteenth century was, however, the era of turnpike roads, with tolls that varied from a penny for horses to sixpence for wheels. The turnpike legislation became stupendous, the Turnpike Acts ran into thousands, and there was much jobbery and many abuses. Other Acts were passed for the construction and maintenance of highways, and to such little purpose that, as the author of the book says, the only material change in the condition of the roads was that produced by the climate, which converted them from dust-pits in the summer to pools of mud in the winter. That too sounds rather like India.

The idea that road-making required special knowledge was slow in gaining ground. There were no professional road-engineers in the eighteenth century, and it fell to gallant John Metcalf to give road construction a start. Metcalf had been blinded by smallpox at the age of six, but refusing to be intimidated by his misfortune, he became an expert boxer, wrestler, a horseman riding to hounds, and at the age of forty he turned his attention to road-making. He designed and constructed roads and bridges, and instead of skirting bogs and marshes as had been done before, he devised a special kind of road to cross swamps. Then, with a gap, came the age of Telford and Macadam. Thomas Telford rose to be an engineer of great distinction, and his name will always be remembered if only on account of the Telford Premium of the Institution of Civil Engineers. He was a great road-maker and bridge-builder, and he was followed by John Loudon Macadam, whose name will not be forgotten owing to the road-surface called after him. He was more than an engineer, he was famous as a highway administrator, and both he and Telford did invaluable work in the time before railways began to put the nose of roads out of joint. There were eleven hundred turnpike trusts with an income of £1½ millions when what was called "the calamity of railways" occurred. But if that event diverted attention from roads to railways, the roads had their revenge by the coming of the motor car. Motor cars very quickly gave roads an importance they had not previously possessed. The roads were narrow, winding, steep in gradients, and above all their surfaces were unsuitable. The new traffic cut the roads to pieces, and again the question arose as to whether the roads should suit the traffic or the traffic the roads. This time the answer was not for a moment in doubt, the self-propelled vehicles had come to stay, and roads had to conform to their necessities. The result was amazing, the road revenue rose from £867,493 in 1911 to £18,451,213 in 1926.

That, then, was the great turning-point in the history of the modern highway, the number of motor vehicles increased from 100,918 in 1911 to 1,023,651 in 1926. In the same period the mileage of British roads increased from 175,487 to 178,361, and it is very important to note the vast increase of expenditure in comparison with the small increase of the road mileage. Apart from the activities of the Road Fund, as given above, a rise from £867,493 in 1911 to £18,451,213 in 1926, the expenditure of local authorities increased from £18,642,331 in 1911 to £55,632,521 in 1925, and in addition a large sum was disbursed by the Exchequer every year for road construction and repairs to relieve unemployment. Starting with a sum of £1,220,000 in 1920 this item rose to £2,500,000 in 1926. These staggering figures reveal the immense change that has taken place in the whole system of highways, and the conclusion of Mr. Hartmann's interesting story is worth reading in India, as giving some idea of the recent progress in the West. England was no better than India once upon a time, but the way in which she has now responded to the march of events should give India some food for thought.

Notes and Comments.

Empire Flax-growing.—In their report for the year 1927 the Linen Industry Research Association state that excellent samples of seed, straw and fibre were received from South Africa, indicating the possibility of considerable opportunities of flax-growing there. Enquiries were received from Kenya, S. Rhodesia, Egypt, India and Cyprus.

St. Paul's Dome.—A chain to hold the dome of St. Paul's Cathedral in its place is being made at Brown and Bayley's steel works in Sheffield. The chain is unique in that it is of stainless steel. It is 145 feet long (each link is over 15 feet), 13½ inches wide, and weighs 30 tons. It is to be embedded in concrete in St. Paul's dome to prevent the dome sagging and preserve its shape.

Artificial Silk Profits.—Messrs. Courtauld, the great artificial silk manufacturers, have returned profits exceeding £4½ millions for the year 1927. The dividend for the year is 25 per cent., free of tax, and 100 per cent. bonus by the capitalisation of £12 millions from Reserves. The capital of the Company is now £32 millions. Shares stood at 7 11/16 last week.

Aerial Survey by Sir Alan Cobham.—Sir Alan Cobham informed a correspondent at Cairo that, while he was going to carry out a survey of aerial communications round Africa, a highly interesting portion of the work would be from Abukir to Mombassa. He had been commissioned by the Air Ministry and the Colonial Office to investigate the possibilities of flying ship communications along the Nile.

Communications on the N.-W. Frontier.—The Government of India have sanctioned the construction of an unmetalled road from Thal on the Kurram River at the terminus of the Kohat-Thal Railway, to Idak in the Tochi Valley, at an estimated cost of Rs. 17,87,000. A wireless station has been set up at Spinwam where the road will cross the main tributary of the Kurram River. In the Tochi Valley wireless stations have been set up at Miran Shah and Datta Khel.

What is an Expert?—During the Budget discussion while Mr. Ranga Iyer in his speech referred to the demand for Indianisation of the Railway Board and suggested that the man chosen must be an expert, he was suddenly confronted with the demand to define an expert. His ready reply was that "an expert was one who combined technical knowledge with efficiency, and inward acquaintance with the working of the system." Strict adherence to definition would considerably attenuate supplies.

Capital Projects in the Punjab.—As regards the Capital Account, it was stated by the Finance Member in presenting the annual Budget, that it was proposed to incur expenditure to the extent of Rs. 183 lakhs, or Rs. 23 lakhs less than in the Revised Budget of the present year. The works were the Uhl Hydro-Electric scheme and the Sutlej Valley project. The sanctioned Uhl Hydro-Electric project estimate amounted to Rs. 420 lakhs. The estimated expenditure to the end of 1927-28 would be Rs. 61 lakhs and the Budget estimate for 1928-29 was Rs. 46 lakhs.

Thames' Retaining Wall Strengthened.—A new concrete wall has now been erected on the riverside from Old Lambeth Bridge to Page Street, one of the scenes of the recent disastrous floods. This wall is 3 feet thick and is erected in front of the existing brick wall. Where the Thames actually burst through, the concrete is 5 feet thick. This is, however, only a temporary measure as it is intended to widen the road in the near future. In front of the Tate Gallery another concrete wall 2 feet thick has been erected.

Bally Bridge.—The Committee of the Calcutta Chord Railway at a meeting held recently considered the representation of the Bally Municipality in connection with the sanitary problems of the town due to the construction of viaducts for the railway lines. Amongst those present were Mr. A. W. Cook, Commissioner of the Burdwan Division, Mr. G. S. Dutt, District Magistrate, Howrah, Chief Engineer of the Calcutta Chord Railway, and the Chairman of the Municipality. It is reported that the Committee has decided to look after the sanitary arrangements.

Bhatpara Sewage Scheme.—With a view to protesting against the proposed sewage scheme at Kankinarrah within the Bhatpara Municipality, which is likely to be taken up shortly, a meeting of the ratepayers of Bhatpara, Shamnagore, and the neighbourhood was held on Sunday last. The Commissioners were asked to abandon the project, which, it was stated, would in no way benefit the ratepayers. It was also stated that the scheme would be a failure as had been the case at Tittaghar. A copy of the resolutions passed will be sent to the Government.

More Concrete Houses.—According to the returns issued by the Ministry of Health there were more concrete houses erected in Great Britain during 1927 than in any year since the Subsidy was introduced. 41,277 concrete houses have now been subsidised by the Government of which 18,373 were completed last year. Not only are these houses being erected by Local Authorities but many builders prefer them from a speculative point of view, which is ample evidence that the old prejudice which existed against this type of construction is now rapidly dying out.

Wagon Shortage on the E. I. R.—The working of the East Indian Railway for the week ended 18th February shows that the loading of coal had to be restricted on 11th and 16th February to loco. and specials only due to a shortage of empties. The demands in coalfields were very heavy and coal allotment was over 1,000 wagons short of the indents for these two days. The traffic, both coaching and goods, carried by ferry between Sakrigali Ghat and Monihari is increasing, and as the limit of capacity has been nearly reached, it is under consideration how the carrying capacity can be increased.

Shortage of Tin.—The world produces 150,000 tons of tin annually, half of which is consumed in America. The supplies cannot be appreciably increased while the reserves are being used up. The consumption in the canning industry has nearly trebled during the last five years and the motor industry has more than doubled its consumption of tin in the same period. Lord Askwith, at the Colonial Institute on the 22nd February, urged the need of conserving tin supplies, the greater part of which came from the British Empire, either by the merging and trustification of tin companies or by co-operative selling.

Cuts in Budget Grants.—Three more cuts were considered in the Bombay Council besides those relating to the Development Department, as a consequence of which the Nariman Committee of Enquiry has been appointed to take up questions of bribery and corruption from the inception of the Back Bay scheme. Two related to the Sukkur Barrage and other irrigation works in Sind. The Sindhi bloc was united against the provision for the construction of a regulator in the Ex-Begari Canal, the chief contention being that the regulation of the water supply would be placed in the hands of subordinate Government officials. It was declared that the Sind zemindars were entirely opposed to such proposals.

E. I. R. Excursion Train.—The East Indian Railway authorities propose to run a conducted tour special for students in Northen India during the forthcoming Easter holidays, provided a sufficient number of students will avail themselves of the opportunity. There will be an inclusive charge of Rs. 60, with second-class accommodation, and including all meals and cost of conveyance for sight-seeing at the places to be visited. Students will have to apply through the Principals or Headmasters as the case may be. As at present arranged the proposed train will leave Howrah station at 7-50 P. M. (Calcutta time) on 2nd April and return at 6 A. M. on 10th April after visiting Benares, Hardwar, Rishikesh, Delhi, Agra, and Bindhachal.

Bahawalpur Feeder Railway.—At the Engineers' Congress in Lahore Mr. Kunzru's paper described the construction of the Cholistan Railway in Bahawalpur State, which is a light feeder line of the cheapest possible type, 63½ miles long. It will traverse a tract of desert from the Sutlej riverain to the dry bed of the Hakra River, through a practically unpopulated region, now about to be irrigated by the Sutlej Valley Canal which leaves the Sutlej at the Suleimanke Weir. It is anticipated by the advisers of the Durbar that losses incurred in working the railway will, in time, be covered by an increase of revenue due to the canal—*if sufficient water can be supplied* for the enormous areas of irrigation promised by the canal project, some would like to add.

East African Federation.—Owing to representations from East Africa and North Rhodesia a Commission of experts was appointed to make enquiries—especially financial—the members agreeing to receive merely their expenses, for which £2,500 was voted in the House of Commons. Mr. Ormsby-Gore quoted from the League of Nations mandate to show that the mandatory power was authorised to constitute a territory so held into a federation with adjacent territories under the mandatory's own sovereignty. The welfare and progress of the natives was a matter that was not entirely one for the agents of the Imperial Government in East Africa; the responsibility rest on all non-African communities residing in the territories, said Mr. Ormsby-Gore.

Napier Engines.—A British Official Wireless states that the remarkable Napier engine used in Flight-Lieutenant Webster's seaplane which won the Schneider Trophy air race in September last and which, in Captain Campbell's car, has just raised at Dayton the world's speed record on land, is to be given a third task of gaining a world's speed record on water. The engine will be adapted to a motor-boat which will be driven by an Englishwoman, Miss Carstairs. The present motor-boat record is 80·56 miles an hour. The Napier engine has twelve cylinders arranged in three rows in the form of a broad arrow and although it only weighs 850 lb. it gives 875 horsepower. Its compression ratio is almost ten to one, and it is regarded as the most highly-developed engine in existence.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 23rd February:—Messrs. Martin and Co., Calcutta—Dragline Excavator Spares, for Ruston No. 135, Rs. 1,135 c. i. f. Karachi free delivery; 298 cwts. 4 lb. Joists, R. S., 5 inches by 3 inches, British, Rs. 2,236 f. o. r. Howrah; 348 cwts. 24 lb. Joists, R. S., Rs. 2,644 f. o. r. Howrah; Messrs. Jessop and Co., Ltd., Calcutta—1 Crane, 1½ ton, overhead, hand power, single girder, complete with sufficient crane rails, Rs. 1,000 free delivery at Dera Ghazi Khan by 1st May 1928, at Karachi; 8 Joists, R. S., Rs. 1,520 f. o. r. Howrah; Messrs. Turner, Hoare and Co., Ltd., Bombay—Spares for Milling Machine, Rs. 1,450 free delivery at Bombay by 15th May 1928.

British Industries.—Captain Hacking, Under-Secretary for Overseas Trade, stated that the result of the British Industries Fair in London and Birmingham had been eminently satisfactory. There were 256,000 square feet of exhibition space in London, and 180,000 square feet in Birmingham. Both figures beat previous records and represented a total increase of 130,000 square feet over last year. The attendance was also a record, being in London 103,586 and in Birmingham 103,000. A large amount of space had already been booked for next year's fair. This year's exhibition had been of real practical benefit to all sections of British industry, and he was satisfied it would lead to an increase of business. Asked if he would consider whether the fair could not be put on a more permanent footing and be held for a longer period, Captain Hacking replied this was being considered.

Calcutta Advisory Committee, E. I. R.—Mr. Colvin, Agent, East Indian Railway, who presided over the 50th meeting of the Calcutta Advisory Committee of the Railway, on 2nd March, stated that traffic had fallen off during the three weeks ended 18th February, though it had improved in the succeeding week. The earnings exceeded Rs. 45 lakhs, and were about Rs. 1½ lakhs better than the figure for the corresponding week of last year. The rest of the time was occupied in discussing various questions dealing with rates and fares, which Mr. Barman had tabled for discussion. The Agent explained that the administration would shortly have to face a prospective heavy loss in earnings due to the reduction in third-class fares, the co-ordination of rates on the Oudh and Rohilkhand section, and reduction in parcel rates and other commodities, and until he knew whether these reductions would give the necessary incentive to traffic necessary to make up the prospective loss, he did not feel inclined to agree to any other reductions.

Indian States.—Again the proceedings of the All-Parties Conference in Delhi were, it is said, held *in camera*. It is understood that the question taken up on the 22nd February related to the relationship with the Indian States, but the discussion was adjourned pending settlement of other matters. It is stated that a provisional agreement in regard to the settlement of the Hindu-Moslem question requires that some disagreements between the Hindu Mahasabha and the Moslem League should first be decided. The Chamber of

Princes has passed resolutions relating to the Indian States Enquiry Committee. Several speeches are said to have been made regarding the scope and procedure of the Committee. For the third year in succession the Maharaja of Patiala has been elected Chancellor of the Chamber of Princes. The decision is generally welcomed, because continuity of a policy so well carried out hitherto will be of advantage in connection with the Butler Enquiry. A subject of discussion which has attracted special interest is the duration of minority rule.

Sale of Sukkur Barrage Reclaimed Land.—The Government of Bombay's proposals for the disposal of land which will be benefited by the completion of Sukkur Barrage were further discussed by the Bombay Legislative Council on 3rd March. The scheme which attracted most attention was the one which proposed the disposal of 350,000 acres of reclaimed land to zemindars at Rs. 15 an acre. It was argued that by the terms of the Government resolution of 1923 on the subject, such large blocks of land were only reserved, and not intended to be given away to any section of the people. This contention was replied to by the Revenue Member who stated that 350,000 acres represented the land, which, according to the system prevalent in Sind, had been forfeited from the zemindars as it had lain fallow for a time, but which had to be returned to the former owners as soon as they were in a position to pay single assessment on it. It was this restoration which the Government proposed to carry out on the completion of the scheme. The proposal had been sanctioned by the House in 1923, and approved by the Secretary of State. A cut of ten lakhs under the Sukkur Barrage, which provoked discussion, was finally thrown out.

Butler Committee.—On a motion put forward by His Highness the Maharaja of Bikaner the Chamber of Princes has passed resolutions relating to the Indian States Enquiry Committee. Several speeches are said to have been made relating to the scope and procedure of the Committee. In replying to the toast proposing his health at a banquet given in his honour by His Highness the Raja of Suket, Mr. J. A. O. Fitzpatrick, Agent to the Governor-General, Punjab States, thanked His Highness and said : " India is moving rapidly nowadays and the Indian States cannot afford to stand still and watch the tide sweep past them. New ideas, new political theories, a new spirit of freedom are abroad in India; and it behoves the States, while relying on the sanctity of their treaties, to set their houses in order and move with the times. I often think that the subjects of a well-governed Indian State are in many ways to be envied by their brothers in British India, and in the last resort the strength of a Ruler must lie in the love and loyalty of his people rather than in any more or less artificial bulwark. We have reached a momentous and critical period in the history of the Indian States with the appointment of the Butler Committee and the deliberations of the Princes will thereby be fraught with a special importance in the coming session of the Chamber."

A Ship that Beats a Train.—In order to expedite travel between Penang and Singapore, a new twin-screw steamer, the " Kedah," has recently been built at Barrow-in-Furness to the order of the Straits Steamship Co., one of the associated companies of Alfred Holt and Co., Ltd., of Liverpool. Indeed, the raked stem, which is a feature of Holt's Blue Funnel ships, is apparent at once in the new vessel. Fully loaded, the 18 knots service speed of the " Kedah " will enable her to do the Penang-Singapore run in about 21 hours, which is shorter than the train journey. The vessel has a length of 310 feet and a gross tonnage of 2,200, with accommodation for 76 European passengers in cabins, and about 800 native passengers between decks. In addition, three holds give extensive cargo space. The main propelling machinery consists of two sets of Parsons type single-reduction geared turbines giving a total normal power output of 5,800 s. h.-p. The auxiliary machinery throughout is very complete and of the latest type. In this connection it is especially interesting to note that electric current is supplied by two 40 kw. turbo-electric generators supplied by Greenwood and Batley, Ltd. These De Laval type turbines are designed for a steam pressure of 150 lb. per square inch and can exhaust either into the heating system at a back pressure of 12 to 15 lb. per square inch or, alternatively, to the main condenser at a vacuum of 28 inches. This equipment adds yet another unit to the many hundreds installed by the Leeds firm for electric lighting, power and ventilation in steamships of all sizes from tugs to battleships. During the successful trials of the vessel on the Firth of Clyde an average speed of 19 knots was easily attained and a full power trial of six hours duration at the contract speed showed a fuel consumption of 0·83 lb. of oil per s. h.-p. per hour for all purposes.

New Tiger Range of Leyland Passenger Models.—Whilst fully maintaining the large production programme of their well-known Lion and Lioness passenger models, the Leyland Company has now put into production after eighteen months' strenuous experimental work a very interesting new range of six-cylinder passenger models which will be known as the Tiger group. These machines, which are of entirely new design in every respect and represent the very latest design as compared with British, American and Continental practice, will be available strictly as alternative to the well-tried four-cylinder models of which so many are now in service. The Tiger will be the full-capacity single-deck passenger model of the side type ; the Tigress, an equivalent model but of bonneted pattern ; the Titan, the new six-cylinder double-deck 'bus, which in this instance entirely supersedes the Company's previous double-deck models. In addition, production has already commenced of a further example of this six-cylinder range known as the Titanic, a 3-axle version of the same design adapted for maximum passenger capacity. It is a double-decker, seating up to 72 passengers. Some of the interesting features of these new models include a very fine example of six-cylinder overhead-valve engine design, unit construction of engine, clutch and gearbox, off-set transmission line, underslung worm, open transmission, 11-inch frame, four-wheel brakes, power-operated brake mechanism, and in the case of the double-decker, a most interesting design, remarkable for the double-deck overall height figure of 13 feet. Examples of the Titan and the Tiger were exhibited at Olympia, and the Titanic, the 3-axle machine, was available in London for inspection during the run of the Olympia Show. Other exhibits on the Company's Stand at Olympia were the " Lion " single-deck 'bus, and an example of the latest high-speed goods vehicles which are now fitted with new detachable-head engine and pneumatic tyres. Other examples of Leyland chassis were displayed in the Coachwork section.

Current News.

MR. E. L. GLASS, Superintending Engineer, P. W. D., Central Provinces, is transferred to Bihar and Orissa.

AN aerial survey is being carried out with the object of finding if the river Zambesi is navigable through its upper reaches in Barotsoland.

ABOUT 14,000 workmen employed at the Carriage and Wagon Shops of the East Indian Railway at Lillooah have been idle since Monday last.

THE Council of the British Association has nominated Sir Thomas Holland president for the meeting of the Association in South Africa in 1929.

ARRANGEMENTS are being made by the local Chambers of Commerce for the thorough investigation of the oilfields of the Sinkiang province of China.

SIR WILLIAM WILLCOCKS had the honour of lunching with His Excellency the Governor and the Hon. Lady Jackson at Government House, Calcutta.

SOME coal mines which has been discovered in the Hsi-an Prefecture in the Jungshan district of Manchuria, are to be exploited at a cost of about £600,000.

AN aerial survey of 20,000 square miles of country near the Congo-Rhodesia border is being carried out, and already more than half the country has been photographed.

MR. A. L. OJHA, M. L. C., AND MR. M. N. MUKHERJEE, have been elected Chairman and Vice-Chairman, respectively, of the Indian Mining Federation for the year 1928.

A GIANT electric locomotive destined for the Great Indian Peninsula Railway has undergone trials at Newcastle. It develops 2,400 horse-power equivalent to a speed of 85 miles an hour.

THE total approximate gross earnings of State railways up to 18th February 1928 amounted to Rs. 90·25 crores, or Rs. 370 lakhs more than the figures for the corresponding period of the previous year.

SOME emerald crystals as large as 2 inches long by 1¾ inches in diameter have been discovered at the new workings near Somerset, Transvaal. They were found at a depth of only about 10 feet below the surface.

THE bridge which it is proposed to construct across the river Tees at Newport will give a headroom for navigation of 160 feet. There is, however, some discussion as to whether the main span should be 200 feet or 250 feet.

MR. J. R. D. GLASCOTT, Agent of the Burma Railways, and Mr. W. T. Howison of Messrs. Steel Brothers, Rangoon, have been elected Chairman and Vice-Chairman, respectively, of the Burma Chamber of Commerce.

WHAT is said to constitute a record in steel work has been created at the Clydebridge Steel Works, Cambuslang, where a total of 6,532 tons of steel plates rolled by the universal three-high mill has been turned out in an ordinary working week.

THE Southern Railway is fitting to some of its locomotives a plate on each side of the smoke-box whereby the current of air over the front of the engine will be forced upwards and so lift the smoke and steam from the funnel clear of the driver's vision.

DURING the present year the Southern Railway proposes to build thirty-eight new locomotives, ten of which will be of the "Nelson" class. It is also proposed to build 1,650 open goods wagons of 12 tons capacity, which, it is said, will cost over £250,000.

AN exhibition indicating the possible utilisation of overseas Empire timbers has been opened at the Imperial Institute. The exhibition is the second of a series intended to attract attention to the resources of the Empire, and will remain open until 30th April.

THE turret-clock, four double-dial platform clocks, and sixteen other clocks at Newton Abbot, Great Western Railway, are all electrically controlled by one and the same circuit. A beginning has been made with a similar control for the clocks at Paddington.

THE total approximate gross earnings of State railways for the week ending 18th February 1928 amounted to Rs. 221 lakhs, Rs. 7 lakhs more than the figures for the last week, and Rs. 4 lakhs more than the figures for the corresponding week of the previous year.

A PROPOSAL has been put before the local authorities in Lancashire for spanning the estuary of the river Ribble with a bridge near Blackpool. The bridge would have two decks, one for vehicular traffic and the other for a species of tramway. It would be 2½ miles long, have a navigation span of 6,000 feet and provide a headroom of 85 feet.

THE largest aeroplane ever constructed in Britain made its successful maiden flight from the Air Ministry's experimental station at Martlesham Heath, Suffolk, on 6th March. The machine is the first big all-metal monoplane built by Britain. It weighs nearly 20 tons, and is driven by three Rolls-Royce engines with a total of 2,100 horse-power.

Literary Notices.

Industrial and Railway Amalgamations.—By Sir Josiah Stamp, G. B. E., D. Sc., Chairman and President of the Executive, London, Midland and Scottish Railway. London General Press, 3, Arundel Street, Strand, W. C. 2. Price, 2*s*.

Those who are interested in this subject will find this booklet of absorbing interest. A study of its pages will suffice to prove the great importance of the matter. It requires a careful study of the subject.

Lightning Conductors.—Steeplejacks and Their Work. By Mr. G. A. Collier, Engineer and Manager of Lightning Conductor and Steeplejack Department, W. J. Furse and Co., Ltd., Steeplejacks, Lightning Conductor Specialists, Nottingham.

This is a reprint of the fifth lecture and is one full of interest, as there is much doubt and misconception in the lay mind of the public regarding the question of lightning conductors, efficiency of same, etc. Steeplejack evinces more than ordinary interest. The firm will be pleased to send a free copy to all interested trade readers of this publication from their head office at Nottingham.

Electro-Farming.—Or the Application of Electricity to Agriculture. By R. Borlase Matthews, Wh. Ex., A. M. Inst. C. E., M. I. E. E., F. R. Ae. S. London: Ernest Benn Limited, Bouverie House, Fleet Street, E. C. 4. 1928. Price, 25*s*. net.

This is an important and valuable volume of which all agriculturists should possess a copy and carefully study if they wish to make headway and prosper. Mr. Borlase Matthews, who has a world-wide reputation for practical research work on his own estate at East Grinstead, and occupies an unique position as an expert in electricity and successful farming, sets forth the great advantages to be derived from the application of electricity to agriculture and shows how far behind other European countries we (in England) are in this respect. The book is demy 8vo., and is profusely illustrated.

The Port of Hamburg.—With plans, charts and numerous illustrations. By Dr. Ing. L. Wendemuth, Oberbaudirektor, Wasserbaudirektion, Hamburg, and Dipl. Ing. W. Böttcher, Baurat, Kaiverwaltung, Hamburg. Issued by the Deputation für Handel, Schiffahrt und Gewerbe and the Baudeputation, Sektion für Strom-und-Haffenbau. Hamburg: Meissner and Christiansen, Publishers. 1927.

This very handsome and beautifully illustrated volume contains valuable information relative to the Port of Hamburg. Hamburg forms the most easterly link in the chain of great North Sea ports that constitute the gates through which a considerable percentage of the trade between Europe and the overseas countries must necessarily pass, and there can be no doubt that this fact has very largely contributed to her position as an important centre of international traffic. This book proposes to briefly review her geographical situation before giving a detailed description of her port and its equipment. The whole volume is a work of art, which does great credit to the publishers. The learned authors are to be congratulated on the excellent manner in which they have accomplished their work.

Researches on Springs.—1. The Endurance of Spring Steel Plates under repetition of Reversed Bending Stress. By G. A. Hankins, A. R. C. S., B. Sc. London: Published under the Authority of His Majesty's Stationery Office.

This report is the first of a series of reports which will be issued, at frequent intervals, in the Engineering Series of the Department of Scientific and Industrial Research giving accounts of the most important investigations carried out under the supervision of the Spring Research Committee of the Department, and of the results obtained therefrom. This Committee came into being as the result of war time experience of the great trouble and expense arising from the frequent failures of laminated springs fitted to motor vehicles. It was realised that there were many obscure factors involved in the design, manufacture and use of laminated springs, and that the research and design data immediately available were largely derived from horse-drawn road carriage and railway experience, necessitating a careful study of the composition and choice of materials, the heat-treatment to be applied and many other matters. The Committee which was accordingly set up to conduct investigations into the most suitable materials and design of laminated springs and also of coil springs is composed both of representatives of industry and Government representatives. Reports on the measurement of the displacement of vehicle springs under road running conditions, on torsional fatigue tests on valve springs, and on the surging of valve springs, will shortly be issued.

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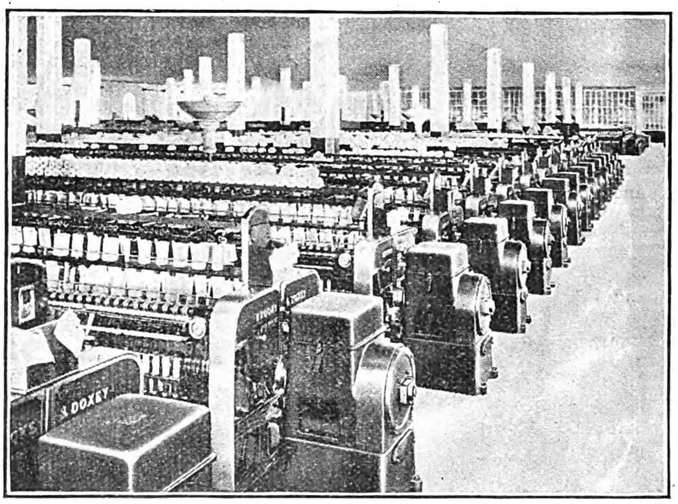

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Foreign Notes.

Storing Energy in the Ruhr District.—A novel method is to be used in the Ruhr district to store the surplus electrical energy not required during night shifts, holidays, etc. A large reservoir is to be established in the hills at Herdecke for storing water. All the available surplus current is to be used for driving pumps which will lift water up into the high-level reservoir. The water power thus stored is to be used to drive turbines to assist the generators during the day shift, and more especially to enable them to deal with any peak loads.

Canadian Lakes and Canal Steamers.—The first two of seven vessels under construction by Messrs. Swan, Hunter and Wigham Richardson, Limited, for Messrs. Paterson Steam Ships, Limited, Fort William, Ontario, Canada, were launched recently at Wallsend. These ships, the single-screw steamers "Cartierdoc" and "Lavaldoc" are each 253 feet long, with raised quarter-decks and sunk forecastles. The engines, which will be placed at the after end of the ship, are of the ordinary marine type with three cranks. The propelling machinery and boilers are being constructed at the Neptune Works, Walker-on-Tyne, of the builders.

Electric Motors on German Farms.—The electric motor is used more than any other type of power equipment on German farms. A total of 746,810 electric motors, having a combined horse-power rating of 3,334,051, is employed. These motors represent 80 per cent. of all the power equipment used, and the only exception to the overwhelming use of the electric motor is on farms having an area greater than 200 hectares. While the electric motor is the predominating source of power on farms under 2 hectares in area, the total horse-power used is small in comparison with that used on the farms in the 50-hectare class, 90 per cent. of the power employed on these farms being provided by electric motors.

Floating Docks.—Some of the ports in France have already been equipped with floating docks supplied by Germany on account of reparations, the largest of them having been delivered to Bordeaux during the past year, and it is proposed to obtain from Germany another 25,000-ton floating dock for Havre. The 8,000-ton dock which arrived at Rouen recently has been officially put into service. It is of the most modern type, with arrangements for raising damaged vessels which are unable to enter the dock under steam. The Rouen Chamber of Commerce hopes to obtain from Germany two other floating docks, one of 2,400 tons and another of 8,000 tons. This equipment is intended more particularly for the oil tankers which, it is hoped, will come to that port.

Breathing Apparatus for Use on Ships.—Every passenger ship carrying a Board of Trade certificate is required to have, ready for immediate use, auxiliary breathing apparatus to enable an officer to explore with safety any compartment in which a poisonous atmosphere is suspected. To meet these requirements, Messrs. Merryweather and Sons, Limited, Greenwich Road, London, S. E. 10, have designed an apparatus which has been named the Kaskor set. It consists of a smoke helmet having head and face pieces blocked from hard leather, and a soft-leather portion cut and seamed to fit round the neck and shoulders. The three portions are secured together by means of lightning fasteners and metal clips, so that the face can be uncovered instantly when necessary. The face piece is fitted with mica panes in front of the eyes, and has a gunmetal screw fixed by a brass clip for the attachment of the air hose. Air is supplied to the helmet from an external source by means of hand-worked bellows and a length of flexible hose pipe.

Steam Accumulators.—At a meeting of the Junior Institution of Engineers in London recently, Mr. Stanley Hopkins, discussing the subject of "Steam Accumulators," said that the principles of steam accumulation by storage of heat in water had been long known, but their exploitation had been recently revived, and the method of their utilisation in industry had evolved a new means of economy. A steam accumulator was generally of value only where the demand for or supply of heat in a works was fluctuating, and then by storing heat when the supply exceeded the demand and by giving up the reserve of heat when the demand became greater, an accumulator enabled the boilers to work at a more uniform and efficient rate, besides giving the advantages of a reserve for peak loads. The two systems of accumulation generally adopted were known as the falling-pressure and constant-pressure systems. The first depended on the condensation of steam in water under rising pressure and its discharge as steam under falling pressure. In the second system the water heated up by steam in the accumulator was used as boiler-feed water on discharge, and only so much water was used as would take up the available heat. Proper means of control of this system had been devised, and the system has been installed a good deal on the Continent, where it was giving results worthy of attention.

A Notable Ellerman Liner.—According to "The Engineer," on 31st January successful trials took place off the Tyne of the new high-speed cargo liner, the "City of Roubaix," which has been constructed for the Ellerman Lines, Limited, of London, by Swan Hunter and Wigham Richardson, Limited of Wallsend. The "City of Roubaix" is the second ship to be completed of three similar vessels which her owners have ordered to determine the comparative propulsive performances of high-pressure reciprocating steam engines, geared steam turbines, and oil engines. The first ship, which was completed towards the end of last year, was the "City of Canberra," in which were installed high-pressure quadruple expansion steam engines, while the third is the "City of Lille," which will be propelled by Doxford type oil engines, and is now under construction at the Clydeholm Yard of Barclay, Curle and Company, Limited, Whiteinch, Glasgow. In the "City of Roubaix" the propelling machinery consists of a single screw arrangement of Parsons impulse and reaction type turbines, built by the Wallsend Slipway and Engineering Company, Limited. The turbines are arranged in three stages, and are supplied with steam at 303 lb. pressure and 175 Fah. superheat from four main boilers, which are also fitted with Howden-Ljungstrom air preheaters as well as superheaters. An oil-burning equipment is fitted, should it at any time be desired to change over to oil burning. Steam for auxiliary purposes is raised in a single 160 lb. pressure boiler. Most of the engine-room auxiliaries are electrically operated, and current is provided by steam turbine-driven generator sets. The "City of Roubaix" is designed for a service speed of 14 knots, and she has a length of 455 feet with a deadweight carrying capacity of 10,710 tons.

Moffat and Cascade Tunnels.—The "Railway Gazette" states that it was expected that the first train would be run through the Moffat tunnel at the end of January. The excavation of the main or railway tunnel was finished on 10th December, after which the lining was to be completed and the track laid. Steam operation has been decided upon, and special studies are being made of the ventilating plant and conditions. Although the tunnel has been completed, its function as part of a new and shorter route to the Pacific has not yet come into operation, as this will require the extension of the Denver and Salt Lake Railway. Meanwhile, the 6 miles of the Moffat tunnel is being eclipsed by the 8 miles of the Cascade tunnel on the Great Northern Railway in the Cascade mountains, Washington, on which rapid progress is being made, and which is expected to be completed by the end of November of this year. On 1st December 1927, there remained over 5,000 feet to be driven between the two pioneer headings that are approaching each other from opposite portals, and in the main tunnel, about 17,800 feet remained to be enlarged. Concrete lining started at the west and east portals in May and July, respectively, of last year, and the best month's lining record was 1,425 feet. The total length of tunnel lined on 1st December was 12,847 feet. The completion of this tunnel will at once materially improve operating conditions on the Great Northern Railway.

Concrete Roadbed for Railway Track.—Many experiments have been made with designs of concrete and ferro-concrete sleepers, but the "Railway Gazette" gathers from a paper read recently before the American Maintenance of Way Club by Mr. Paul Chipman, of the Pere Marquette Railway, U. S. A., that an experimental section of concrete roadbed has given good service under extended test. It is 1,326 feet in length, and is inserted in one track of a double-line section of a main route near Detroit. It consists of 34 slab sections, 21 inches thick, 10 feet wide, and 39 feet long. In addition to ordinary reinforcing bars a light steel truss is embedded in the concrete directly beneath each rail. The upper chord of this truss consists of two ¼-inch by 4-inch steel plates placed vertically with the upper edge slightly below the surface of the concrete. These trusses are connected with each other at intervals by brace frames and adjustable tie rods. Attached to the steel plates at intervals are steel stirrups for the rail fastenings. The rails are held in place by clips bolted to these stirrups. On the basis of the first year's service it was reported that there had been no undue disintegration of the concrete beneath the rails, nor any undue battering of the rails themselves. Trains rode on the section quite smoothly, so that there were no indications of deleterious effects, though the section was too short to provide conclusive evidence. As to the joints, "it would be hard to find a piece of ordinary track in use a year, under like traffic, that would show a better record."

The London Terminal Air Port.—On 30th January, use was made for the first time of the new buildings of the London Terminal Air Port, which have been constructed adjacent to Purley Way, Croydon, says "The Engineer." The first machine to take off from the broad concrete floor, which is carried right up to the departure and reception offices, was the 8 A. M. Imperial Airways machine for Paris, which was followed later in the day by several British and continental planes, both departing and arriving. The new taking-off floor has been found to be very convenient, for the wind in the prevailing quarter favours the take off, and, moreover, the departing machine has the whole stretch of the aerodrome in front of it. Although the official opening of the new station will not take place until the early summer, three of the large hangars, which measure 150 feet by 300 feet, are now in service, two of them being reserved for the Imperial Airways machines and the other for the machines of the continental lines. Behind each hangar are stores with offices above, and still in course of completion is a series of workshops, in which repairs can be carried out and spare parts made. A feature of the new workshop accommodation will be the installation of a very complete engine testing plant, which has been specially designed by the engineering department of Imperial Airways, Limited, and which will be employed for finally testing for service the five different types of aero engines which are now employed in the machines of the fleet. As yet the new control tower is not in use, and control will be exercised from the old tower until the new direction-finding equipment is ready for service.

Silica Coke-oven Plant of the Consett Iron Company.—A plant comprising a battery of 56 coke-ovens now in the course of erection at the Derwenthaugh Works, near Newcastle-on-Tyne, of the Consett Iron Company, by Silica Coke-oven and Machinery, Limited, of Aldwych House, W. C. 2, the English branch of the Otto Company, of Borkum, Westphalia, is of the new Otto type, with complete by-product recovery. The installation is designed for the carbonisation of 1,500 tons of coal a day, with a coking period of 16 hours, and an oven charge of 18 tons (28 tons maximum). It is claimed to be the largest coking plant in the country. The dimensions of the rectangular oven chambers are 44 feet 7 inches by 14 feet by 1 foot 6 inches. The coal to be used has been tried in the Otto demonstration plant at Dahlhausen on the Ruhr, to which British coke-oven managers recently paid a visit. Silica coke-ovens were first employed early in 1916 by Dr. C. Otto in the Rheinische Stahlwerke, which now have 135 of these coke-ovens. In the chambers there is one descending flue between two ascending flues, the gases entering below, through twin-flow or hairpin flues, which can be regulated both from the top and bottom. There are three regenerators underneath each chamber, two of which are for preheating the air, while the other is for preheating the gas. The discharged coke slides down an incline into wagons which are run to the quenching tower; rubber belts afterwards take the coke to a small coke-screening plant. The by-product recovery plant comprises primary serpentine coolers, turbo exhausters, saturators, ammonia stills, secondary coolers, benzol scrubbers and refiners, and also acid-recovery plant.

General Articles.

INTERNAL CLEANING OF WATER PIPE LINES.

ONE of the difficulties in connection with the bulk supply of water through pipes, not only for towns' requirements but also in connection with many industrial operations, such as cooling water for steam engine and turbine condensers, and general process work, is the formation of internal deposits in the pipe line. This trouble is so universal that the extent of the loss caused is not generally realised, but as giving some idea of the figures involved it is estimated that on the average all the large main water pipes now in operation in Great Britain, no worse than any other country, of 4 inches diameter or over, are reduced in carrying capacity by about 30 per cent., or in other words the total capital expenditure on pipes, representing many millions of pounds, has been increased by this amount in order to maintain the supply, and, of course, in very many individual cases the figures are much worse, even to the extent of 70—90 per cent. reduction of the normal duty. The deposit is caused in a variety of ways, such as animal and vegetable organisms, iron oxide, largely due to the iron forming bacteria Crenothrix, scale from the water, especially calcium carbonate and sulphate, as well as magnesium hydrate, mud, and other solid material, in addition to accidental material such as sand, pebbles, pieces of jointing ring, and even quite large stones which in some way or other manage to get into the water pipes.

One firm who have long specialised in this field of mechanical pipe cleaning are Messrs. Glenfield and Kennedy, Ltd., of Kilmarnock, Scotland, and a recent report of one of their engineers superintending a pipe cleaning job gives some remarkable facts. In this case the pipe was 6 inches diameter, and when the scraping and cleaning device of knives and scrapers attached to a piston had been driven through the pipe for about 30 yards by the water pressure it was impossible to proceed any further. Subsequently the pipe was found to be wedged at this point with five comparatively large stones and shortly after removing these by hand a further jamming occurred, found eventually to be caused by a piece of wood 37 inches long by 3 inches square and no less than 100 bits of stone, together with a large piece of lead. Later on there was discovered another piece of lead actually 33 inches by 2½ inches, due to carelessness in making the molten lead joints. Added to all this there was of course the usual thick incrustation caused on the lines already indicated and the pipe had been allowed to get into such a state that the whole water supply of the town was gradually coming to an end altogether. However, the main was cleaned out entirely and reduced to its original bore.

When the deposits are of long standing the apparatus generally used for the purpose by Messrs. Glenfield and Kennedy, Ltd., consists essentially of three members connected together with universal joints, the first of which consists of two cast iron hollow pistons faced with special segmented leather packing so as to give a watertight joint. In front of the pistons are two jointed composite scrapers, composed essentially of a series of very powerful sprung steel blades, which press up against the sides of the pipe and cut away the whole of the incrusted material, while a series of wire brushes may also be attached to the rear end to drive the débris along in front as they travel. When this apparatus has been put in the pipe through the hatch box, the first few feet having been cleaned by hand, the latter is closed and the water pressure turned on gradually behind the pistons, so that the whole arrangement is forced through the pipe, until finally it emerges at the next hatch box, together with all the débris.

The best practice, however, is to clean the pipes regularly, as it is much easier and quicker to remove a slight and comparatively small deposit than allow this to grow to a considerable extent and become extremely hard, and under these circumstances often a much lighter arrangement consisting of a series of strong wire brushes attached to a water-driven piston is sufficient for the purpose, while if no hatch boxes are included in the main a section of the pipe is removed at intervals.

Illustrations on the opposite page serve to further explain the process of cleaning of water pipe lines.

AN UP-TO-DATE ENAMELLING PLANT.

WITH the enormously increased output of motor cars, new methods in enamelling have been evolved and a particularly interesting plant has been installed at the Coventry works of Messrs. Humber, Ltd.

The new enamelling plant enables the firm to produce motor car wings, front axles and bicycle frames that are impervious to modern road conditions, to bumps and scrapes, and to rust. It can safely be said that any metal parts treated by this enamelling process are for ever rustless.

This result is achieved by a series of processes.

The car wings (made of the finest steel procurable in the country, which has been carefully inspected for blemishes) are taken in the nude, as it were, to the enamelling rooms where they are boiled for an hour in great cauldrons containing an anti-rust solution. This mixture is heated by steam and the boiled wings are cosletised by the process. That is to say, there is a rustless deposit on them when they come out of the cauldrons which is absolutely impermeable. And the wing, when it reappears, has changed from the original steel colour to a soft grey with a bloom on it like a plum.

At the second stage, there are two long tanks in the dipping room. One of these contains a rubber solution, and in this the wings are first dipped. As each one comes out of the tank it is hung up on the rod of a chain conveyor which moves so slowly that only the most careful watching will detect the movement. Here, any superfluity of solution drips off, while the wings creep, an inch every five seconds, upwards to the great black cavern above which is the stove.

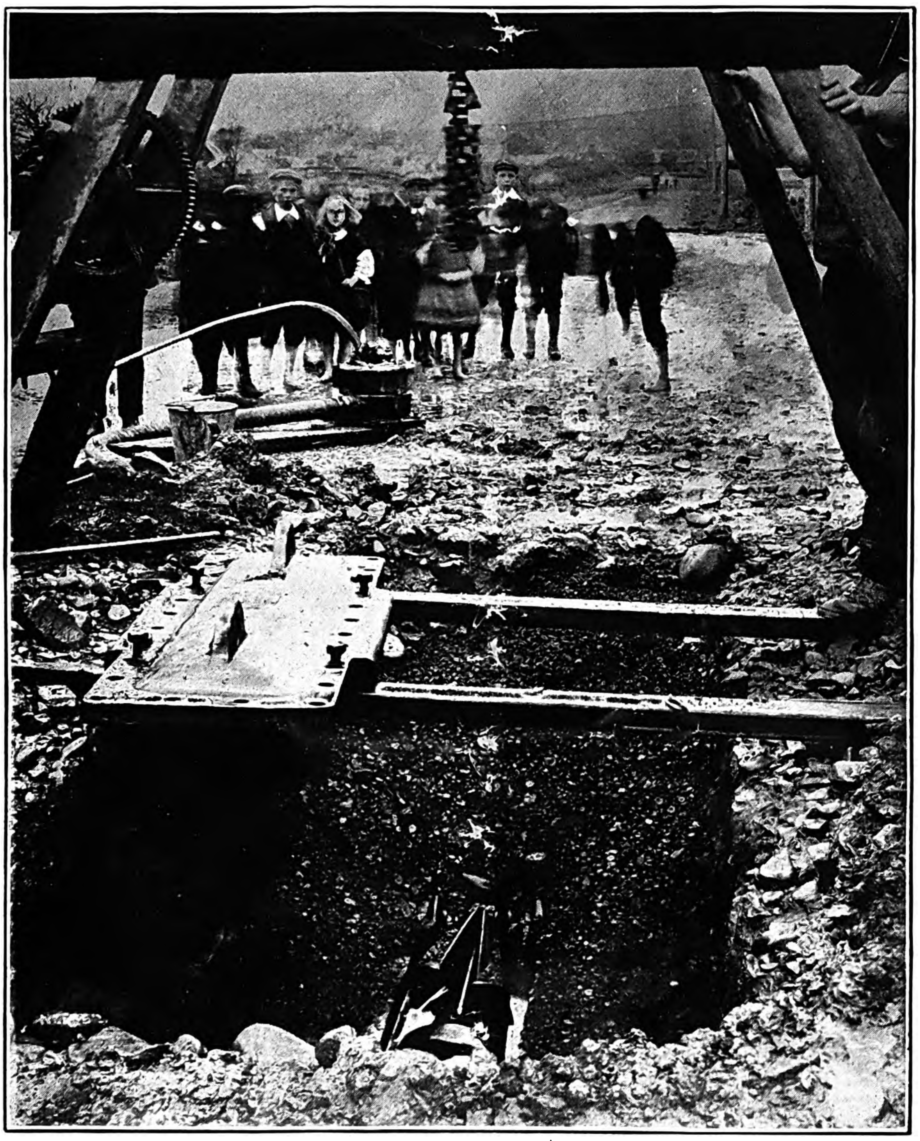
The stove is 60 feet long, encased in 3-inch walls packed with lagging and the temperature is kept at 435 degrees Fahrenheit. The heat is maintained by oil fired furnaces beneath tubular "boilers," in which air is boiled instead of water. It actually reached a temperature of 520 degrees F., but in the stove it has to remain at a uniform level of 435 degrees. There are devices, such as thermographs and thermostatic valves which control the heat in the stove. If the air becomes too hot the supply of oil fuel to the furnaces reduces itself, and when the right temperature has been reached again the fuel jets restart work at the required pressure. As an additional check on the heat there is an observation gallery at the top of the stove and through an opening in the wall is inserted an immense length of thermometer which can be pulled out and read at intervals by the overseer.

The chain conveyor carries the wings slowly through the stove, taking 95 minutes to cover the whole distance and bringing them down again to the working floor level at the end of the time, cooled and ready for the third stage.

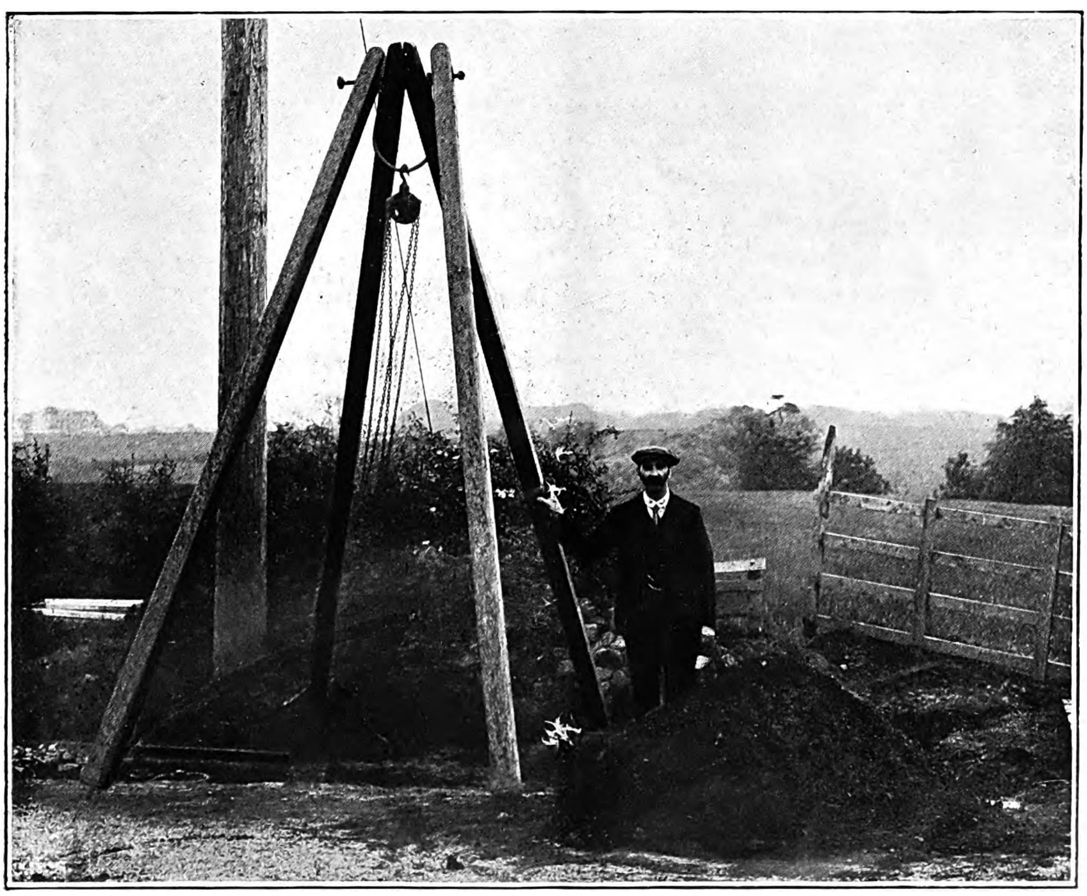
The wings, cosletised and coated with rubber, are then taken to benches where they are smoothed by hand. For this the men use cuttle fish bones which rub down the surfaces to perfect smoothness.

The fourth stage finds the wings back in the dipping room. They are dipped into the second of the two tanks, in which is the enamelling solution, hung on the chain conveyor and passed through the stove in exactly the same way as before.

The fifth stage is a second dipping in the enamel solution and a third passage through the stove. That



Showing Hatch box cover removed and Cleaning Apparatus being inserted in the Pipe.



Typical Pipe Cleaning job in hand (in Scotland) showing the débris removed from one section of the pipe only, between Hatch boxes.

INTERNAL CLEANING OF WATER PIPE LINES.

completes the process. The work has a finish of extreme lustre and a surface so hard that it can be knocked or scratched with impunity. If sufficient force is used with a sharp pointed instrument scratches can, of course, be made on the surface, but these can readily be removed by the application of polishing powder. If the wing is cracked or badly dented only the immediate part in which the steel is exposed can rust. The remaining surface cannot be corroded by the spread of rust.

One of the devices for removing any impurities from the enamel and kerosene is interesting. Such impurities are removed as the mixture is drawn from store for use by a centrifugal separator. This revolves at 7,000 revolutions a minute. Any matter which is not of the same specific gravity as the enamelling mixture is flung out by this rotation and the filtered enamel pours out through special ducts into the containers for removal to the dipping tanks.

SUTLEJ VALLEY PROJECT EXPECTATIONS.

WHEN the worthlessness of the original Sutlej Valley project became too patent to be worked to any longer, a revised estimate (1924) was sent up for sanction, but before it had been pushed through, a second revised estimate (1926) was submitted to the Secretary of State in December 1926 and that of 1924 was withdrawn.

For the tri-partite scheme, in which the Punjab holds a junior share, the cost of the British portion has been considerably advanced, with the result that the estimated percentages of profits have correspondingly dropped. As worked out on three different occasions, at two-year intervals, the percentages of returns on estimated expenditure, on the basis respectively of including or excluding interest derivable from sales of Crown waste lands, are as follow :—

	1922.*	1924.	1926.
Land Sales interest included ...	33	18	13
" " " excluded ...	14	12	7

* Work started on 1920 estimate, unaltered.

The actual expenditure incurred on those parts of the work that have been completed or which are nearing completion, having already greatly exceeded the original estimate, it is the 1926 revised estimate that is being worked to now.

In the five years from December 1921, when the first estimate was sanctioned, to December 1926, when the third was submitted, the expected profits have dropped by 50 or 60 per cent. When a third revised estimate, now overdue, is produced, we may find that these, without including interest on land sales, have become so low that, according to accepted definition, the project has ceased to be remunerative. Fortunately the prices obtained for Crown land sold so far have been abnormally high, which may save appearances under the second method of calculating returns. Even this is uncertain, however, as will be explained.

For Bahawalpur, where low values are being secured for land, as long as Punjab lands are in the market, the prospect is extremely gloomy.

For Bikaner there need be no anxiety, as there has been a minimum of interference with her construction and land sales. The original construction rates have therefore proved sufficient and the disposal of land has remained with the State officials.

In calculating profits the chief factors are, of course, on one side the cost of construction and on the other the probable extent of matured cropping which will bring in the revenue in different forms, while the cropping, in the arid regions of the Sutlej Valley project especially, is a direct result of the quantities of river water available at the right time for the localities where the crops are to be grown and the choice of suitable duties of water. Only one side of the problem has been dealt with so far and that is the costs, while the other has not been touched.

Here we are up against admissions of the most responsible irrigation officers, specially selected for the investigation, that the available water supplies of the combined Sutlej and Beas rivers are insufficient, even if the disputed duty data are taken as correct, to produce the project areas of matured cropping and the revenue. This at once amounts to giving a considered and conclusive opinion that the revenue return of 7 per cent. last claimed is known to be quite wrong as far as the Punjab side of the project is concerned. Hence the 1926 Revised Estimate is of no value already and should be rectified or made to give place to an entirely new revised estimate.

Matters are really worse than has been admitted. The experience of 15 years of water duties actually attained on the adjacent Lower Bari Doab Canal, where the conditions are the nearest approach we have to those dealt with in the Sutlej Valley project, have shown in an unmistakable way that it will be impossible to irrigate more than a fraction of the areas taken credit for, even if the water supply had not been found by accurate daily measurements, taken for the last 8 or 9 years, to be alarmingly inadequate, and even if the Sutlej tributary supply (intended to be removed for Hissar and Bikaner under another scheme) is included in the calculation for arriving at the cropping. The revision of areas of irrigation is imperative if the estimate of returns is to represent anything like the results of known conditions.

There has been a steady but considerable fall in the price of borrowed money since construction started. This change is reflected on one side in the cheapening of cost and on the other in reduction of the interest revenue derived from land sales. Experience gained so far in the disposal of land in British and State areas respectively will permit of a more accurate forecast being made for this side of the financial statements than was possible in 1926.

In other ways, too, the 1926 revised estimate is incomplete. For example, financial statements are omitted altogether for the two Indian States, whose interests in the project are more than double those of the Punjab shareholder. These statements are an essential part of *any* irrigation project, and they are especially so in this scheme. Fairly full information already exists. It can be supplemented and completed as required at any given moment from the States concerned to enable the Government engineers responsible for the revised estimates, quickly to draw up the complete financial statements that must be submitted to the Government of India and the Secretary of State before it is possible for them to deal properly with any estimate presented to them for orders.

The figures of expected returns of the Punjab portion of the project which have appeared so far, show a heavy drop from those that were presented in the original estimate sanctioned six years ago. As explained in this note they are known to be far too high still. Financial statements for the States of Bahawalpur and Bikaner have still to be prepared for the information of sanctioning authority, even if the States themselves were to be so accommodating as to declare they are indifferent and are prepared to relieve the Punjab of the trouble involved in completing an essential part of their work.

From this point of view the original estimate of 1920 is complete for each of the shareholders. The percentage of returns on capital expenditure are shown as :—

	Bikaner.	Punjab.	Bahawalpur.
Irrigation revenue only ...	8·9	12·7	14·5
Irrigation including malikana ..	10·6	14·0	16·2
Including interest on land sales ..	35·9	33·6	42·1

These are the figures that were presented with the prospectus and invitation to the Indian States to join in and subscribe for the bulk of the shares in this *magnum opus* of the Punjab Irrigation Service. Since then the glory has been dimmed somewhat and the shareholders are turning their anxious eyes towards the same quarter, whence cometh their trouble and their help, and asking that they may please be told the worst once for all. This can be supplied in a *complete* Revised Estimate 1928. The question appears to be: Should the

patient be told the worst, or should he be kept under the influence of stimulating drugs a litte longer? He has a wonderful constitution!

If the correct course to follow is being blocked by a not unnatural disinclination to "give away one's friends," then why not make over the ingredients to the public, who are not hampered by such considerations, and let them work out the right answers to their enquiries for themselves? Rumours and imputations are getting a big start and the public is becoming irritable and impatient.

1928.

THE KENNEDY FORMULA.

II.

AFTER page 287 (Mr. K. O. Ghaleb) in Vol. 223 of the Civil Engineers, the remarks made by Mr. F. W. Woods, pages 268 *et seq*, must interest the writer. [The writer has not read any more about Mr. Woods' theory than the above, and the mention in INDIAN ENGINEERING.]* The P. K. formula, in terms of b and d would work out into:—

$$V_0 = \frac{3(x+5)}{x+12} \times \frac{d}{3}$$

$$= \frac{d(3b+5d)}{3b+12d}.$$

It appears that Mr. Kennedy, in later years, thought his formula might be improved by the introduction of the ratio b/d. The above equation certainly admits the ratio, but it wholly observes the fact that the Pyramid theory hangs on f $(m=fy)$.

Written another way:—

$$V_0 = d\,\frac{3b/d+5}{3b/d+12}$$

* These articles were all received together on the 30th January.—ED.

Let us equalise this with Kennedy's formula for $d=6·7$ feet, and Kennedy's $V_0=2·84$ feet per second, assuming that the P.K.V_0 is also 2·84 feet when $x=30$ and $b=67$ feet.

TABLE A.

x	b (feet)	m_p	Pyr. V_0	C_k
10	22⅓	4·568	2·566	0·7595
20	44⅔	5·234	2·746	0·8130
30	67	5·583	2·837	0·8397
40	89⅓	5·798	2·891	0·8557
50	111⅔	5·944	2·927	0·8664

Assuming $C_0=1·201$, the Kennedy constant C_k must vary from 0·76 to 0·87, in order that the two sets of V_0 may be identical. The difference in principle between the two formulæ is obvious; and is fundamental. By Kennedy's formula, $v=0·84\,d^{·64}$, the values of V_0 in the fourth column of the table refer to depths (d) respectively: 5·724, 6·367, 6·696, 6·897, and 7·032 feet, with a maximum difference of nearly sixteen inches! The differences on either side of the assumed $d=6·7$ feet, are $-0·976$ and $+0·332$. An uniform V_0 of 2·84 feet per second would apparently heavily scour the narrower sections, and silt the banks and bed of the wider.

The same general remark applies to all the derived formulæ, except that in some cases the + and − are transposed.

If the Kennedy Sections (see Vol. CXIX and Vol. 223 of the Civil Engineers) originally had had the bed-widths he records, and side-slopes of 1½ to 1 which it was expected would alter to Higham's ½ to 1, then a was expected to shrink from 4½ to 1½. Table B which follows shows what the anticipated result would have been.

TABLE B.

DATA.				DEDUCED.				
No.	b	d	Obs. V_0	Cal. V_0	y	x	f	m
1	85	7·0	2·86	2·92	2·33	36·4	2·638	6·15
2	84	6·9	2·91	2·89	2·30	36·5	2·639	6·07
3	86	6·8	2·90	2·87	2·27	37·9	2·650	6·02
4	68	6·7	2·75	2·84	2·23	30·4	2·579	5·75
5	80	6·6	2·83	2·81	2·20	36·4	2·638	5·80
6	70	6·5	2·81	2·79	2·17	32·3	2·599	5·64
7	55	6·5	2·59	2·79	2·17	25·4	2·513	5·45
8	66	5·7	2·55	2·56	1·90	34·7	2·622	4·98
9	66	5·5	2·55	2·50	1·83	36·0	2·634	4·82
10	48	5·5	2·40	2·50	1·83	26·2	2·525	4·62
11	50	5·2	2·52	2·41	1·73	28·8	2·560	4·43
12	61	5·0	2·33	2·35	1·67	36·6	2·639	4·41
13	36	4·8	2·25	2·29	1·60	22·5	2·465	3·94
14	22	4·5	2·15	2·20	1·50	14·7	2·270	3·41
15	14	4·0	2·00	2·04	1·33	10·5	2·092	2·78
16	18	3·9	1·90	2·01	1·30	13·8	2·238	2·91
17	18	3·6	2·04	1·91	1·20	15·0	2·280	2·74
18	16	3·0	1·70	1·70	1·00	16·0	2·312	2·31
19	14	3·0	1·70	1·70	1·00	14·0	2·246	2·25
20	12	3·0	1·80	1·70	1·00	12·0	2·165	2·17
21	14	2·8	1·60	1·62	0·93	15·0	2·280	2·12
22	15	2·6	1·60	1·55	0·87	17·3	2·349	2·04
23	8	2·3	1·40	1·43	0·77	10·4	2·086	1·61
24	11	2·2	1·30	1·39	0·73	15·0	2·280	1·66

The calculated V_0 in the fifth column are obtained by using Kennedy's original formula, $v=0·84\,d^{·64}$, and have been applied, as he intended, to sections of very different outline, *c. f.*, Nos. 6 and 7, 9 and 10, 18 with 19 and 20.

Drafted: *18th November 1927.*
Revised: *2nd January 1928.*

Σ. Φ.

THE CONQUEST OF THE AIR.

(BY A BRITISH CORRESPONDENT.)

LONDON, *16th February 1928*.

LONDON'S NEW AIR PORT.

A VISIT to London's Air Port at Croydon makes it clear that, in its latest guise, it compares favourably with any of the European air termini. The new aerodrome buildings were opened to the public at the end of January and passengers soon discovered the comfort they afford. From the big central block of offices they can now walk out on to concrete paving where the machines are drawn up, so that they no longer have mud or dust to contend with before embarking.

All the air transport companies have booking offices in the central hall where travellers can study the weather conditions prevailing over the continental air routes by means of a large meteorological map. Needless to say wireless plays a great part in the equipment of the aerodrome. The duty officer, for instance, is in wireless touch with all the routes from Europe which serve Croydon and has full powers of control over all flying operations in the vicinity of the aerodrome itself. By means of direction finding apparatus, the required information can be conveyed to a pilot calling for a bearing. Actually, although the control is at the aerodrome itself, the transmitting station is some two miles away and thus, any obstruction by masts is avoided.

The duty officer is really in control, by means of wireless, of the whole of the air routes within a 250 miles radius of London, and can thus render valuable assistance to pilots on their journeys with information of the latest changes in the weather or warnings of other aircraft on converging courses which, under certain conditions, might involve risk of collision.

HUGE HANGARS FOR DIRIGIBLES.

The adequate housing of aircraft is a problem involving various difficulties and when the size of the latest dirigibles is considered it will be realised that their hangars are of colossal proportions. At Howden, for instance, where the rigid airship R-100 is now nearing completion, the shed, if it may be so styled, is 750 feet long, 156 feet high and has a total floor area of 8½ acres.

It is said that this great vessel of 5,000,000 cubic feet capacity, with a gross lift of 156 tons will only weigh, as far as the structure is concerned, some 83 tons. Her engines are, of course, 750 h.-p. Rolls-Royce. An interesting feature of the framework is that it is almost exclusively constructed in duralumin.

A REVOLUTIONARY ENGINE.

The R-101, which is being built by the Royal Airship Works at Cardington, possesses a framework largely built of stainless steel.

The engines of this vessel will be of a type using crude oil fuel and developed by William Beardmore and Co. Known as the "Tornado" this motor runs on a form of cheap crude oil costing something like a quarter of the price of the aviation petrol used in existing aero engines. Of 650 h.-p. it dispenses with carburetter, sparking flugs and magneto.

The performance of this type will certainly be watched with more than ordinary interest, for its extensive employment would, among other things, result in cheaper air travel.

SURVEY BY AIRCRAFT.

One of the fields in which there is a rapidly growing demand for aircraft is that of survey work, and a great deal has already been carried out in this direction in Canada, America and Australia.

Only recently the Great Barrier Reef, covering some 100,000 square miles off the coast of Australia, was successfully surveyed by the Commonwealth Government by means of a fleet of Supermarine-Napier Amphibian machines.

Another big air survey has been concluded by the Anglo-Persian Oil Co. in Papua with the aid of two Supermarine-Napier "Seagulls." In the course of this an area of 10,000 square miles was covered with a view to investigating the general structure of formation in which oil had previously been discovered.

Sir Alan Cobham's ambitious 20,000 miles flight round the African continent is really in the nature of a survey flight in addition to its propaganda aims, for he has in mind the inauguration of various regular flying services in order to link up the more important towns.

His double flight between Entebbe on Lake Victoria and Khartoum, undertaken at the request of the East Africa Governments and the Colonial Office, was a fine achievement. He covered 2,700 miles in four days, the longest stage being 820 miles from Khartoum to Mongalla, which was flown in eight hours forty minutes. Sir Alan is, of course, employing a Short-Rolls-Royce flying boat for his African tour, equipped with two Condor engines.

A REMARKABLE PRODUCTION.

Now that certain restrictions have been removed by the British Air Ministry, it is possible to give some details about the wonderful Napier Lion engine which made victory possible in the race for the Schneider Trophy last year.

Like all the Napier Lions, this engine has 12 cylinders arranged in three blocks of four cylinders each. The bore is 5½ inches, and the stroke 5⅛ inches. A feature is the exceptionally high ratio of 10 to 1.

The overall dimensions are particularly interesting; the height being 2 feet 10½ inches, width 3 feet 2½ inches, and length 5 feet 6¼ inches, enabling it to be installed in aircraft having a small fuselage. Developing 875 h.-p. at 3,300 r. p. m., the engine only weighs 835 lb. so that for every horse-power developed there is under one pound of weight. The oil consumption is about three gallons an hour, while it consumes fuel at the rate of 50 gallons an hour.

The winning Supermarine-Napier machine was actually fitted with an entirely new design double reduction spur gear. This did not alter the frontal area or streamline shape of the aircraft, though it increased the weight to 1·05 lb. per h.-p.

BOMBAY DEVELOPMENT SCHEMES.

ON the Bombay Legislative Department taking up the consideration of Budget grants on the 28th February, Mr. K. F. Nariman moved for a reduction of Rs. 1,79,000 in the demand for Rs. 41·79 lakhs under Suburban Development Schemes. The motion was strongly supported by non-official members who argued that the establishment charges could easily be reduced by the amount proposed in Mr. Nariman's motion.

Government members assured the House that the abolition of the Development Department was under serious consideration, but the work would have to go on, involving the strengthening of other departments that took it over.

The motion for reduction was unanimously adopted on the Opposition giving an assurance that they were prepared to vote a supplementary grant if necessary next year.

Moving a "cut" of Re. 1 in the total demand under the Development Department, Mr. J. C. Swaminarayan raised a debate on the general policy of the Department. It was pointed out that the motion was a censure both on the Department and on the Government as a whole. It was stated that the evidence of corruption which had been disclosed in the Back Bay libel case was hardly a fraction of what Mr. Nariman had declared he still had in his possession.

It was asked what had the Government done after the disclosures in the Harvey-Nariman case, to bring to book officers of the Department who had been proved in a court of law to be corrupt?

Mr. Lalji Narainji declared that, even after the revelations in the Back Bay libel case, the Government were trying to prevent Mr. Harvey from appearing before the Public Account Committee, of which he was

a member, when it wanted to examine him with regard to certain charges.

Replying on the debate the mover of the "cut" said he would agree to the appointment of a non-official committee to enquire into the Department, and if the proposed committee were given sufficiently wide terms of reference and allowed to enquire into the Department from its inception, and if the witnesses appearing before it were given full protection, he would withdraw his motion.

Mr. Cowasji Jehangir, General Member, explained the steps the Government had taken to investigate the allegations since 1921. As soon as Mr. Nariman made them, the Government offered him an opportunity to help them in clearing matters, hut he did not accept it and the only way that seemed open to the Government to get at the truth was to launch a prosecution.

None were more pleased with the result of the prosecution than the Government themselves. All that they had so far done was with the object of bringing to book culprits who had taken bribes and the Government gladly accepted the proposal to appoint a committee to investigate all charges hitherto made against the Department. The committee would advise the Government as to the steps they were taking and would have to take in connection with these charges. It would consist of five members :—

Messrs. K. F. Nariman, Lalji Narainji, Rafiuddin Ahmad, Hussainbhai Lalji, and K. M. Munshi.

CHEMICALS FROM COAL.

BRITISH FERTILISERS FOR OVERSEAS.

THE ramifications and productions of a large coal and iron company are very much more extensive than the average person realises. These huge concerns are brought into close contact with large numbers of other trades by reason of the chemicals, etc., manufactured from the by-products of coal and coke.

Many of the articles, however, which are dealt with by the Staveley Coal and Iron Co., for instance, are not exactly by-products from the coking of coal, but have been commenced as a necessity to supply their own needs, such, for instance, as sulphuric acid, of which the company uses a considerable quantity, the output exceeding 2,000 tons per month.

Another noteworthy development is the electrical side. The utilisation of the waste gases from the furnaces and coke ovens was regarded as a potential source of revenue and, also, a means of reducing the cost of production in all their local mining and manufacturing operations. Thus, at the Devonshire Works, all the power and steam required is obtained from waste gases. There are now installed three large gas engines for the generation of electricity, which are the largest gas engines in the country, each being of 7,150 h.-p. The size of them can well be imagined from the fact that each crankshaft, stripped of the fittings, weighs about 68 tons.

The works alone, apart from any of the collieries, cover an area of 250 acres, and extend over two miles from one end to the other.

The output of that excellent and universal fertiliser, sulphate of ammonia, has recently been increased from 5,000 to 6,000 tons per annum. This is sold direct and not through any association, a large proportion being supplied for use in Great Britain and the remainder exported Overseas. Only the highest possible grade is made, the neutral quality, guaranteed to contain 21 per cent. nitrogen.

The output of benzol will shortly be increased to over 80,000 gallons per month. A considerable quantity is converted into nitro benzole and aniline oil and the plants for the manufacture of these articles are large enough to supply the whole of the English requirements without difficulty. The benzole is particularly suited for the manufacture of dyestuffs, being quite free from the paraffinoid series of hydrocarbons, and the bulk of what is not used locally is sent for the manufacture of dyestuffs.

The distillation of tar, too, is carried out on an extensive scale, 35,000 to 40,000 tons being dealt with annually. So well is the company placed for this that several other coke oven undertakings send their tar to these works to be distilled on a profit-sharing basis. The distillation is carried so far as to include the manufacture of high grade crude anthracene and refined naphthalene, including naphthalene marbles and many other specialities and the manufacture of crude phenol and cresylic acid.

The Gazettes.

Burma, February 8, 1928.

Buildings and Roads Branch.

Mr. A. F. Chapman, I. S. E., officiating Superintending Engineer, made over, and Mr. H. Hughes, I. S. E., Executive Engineer, received, charge of the office of Superintending Engineer, Irrawaddy Circle, on 3rd January 1928.

Mr. R. W. Lindsay, Assistant Engineer, Andaman and Nicobar Islands, is granted eight months' leave on average pay, with effect from 1st May 1928, or such subsequent date as he may avail himself of it. The leave is to be spent out of India and Ceylon.

Leave on average pay for one month is granted to Mr. A. S. Carr. Temporary Engineer, Pegu Division, with effect from 10th January 1928, or the date on which he availed himself of it.

Leave on half average pay for three months is granted to Mr. K. K. Mukerjee, Assistant Engineer, Pegu Division, in extension of the leave granted him previously.

The headquarters of Mr. A. N. Chopra, I. S. E., Executive Engineer, on special duty in the Upper Chindwin District, are transferred from Monywa to Mawlaik, with effect from 31st January 1928.

Leave on average pay for eight months on medical certificate (including privilege leave at credit) is granted to U San Taw, Assistant Engineer. Amherst Division, with effect from the date on which he may avail himself of it.

Leave on average pay for one month is granted to Mr. E. Hyde, Assistant Electrical and Mechanical Engineer, with effect from 3rd January 1928, or such subsequent date as he may avail himself of it.

Irrigation Branch.

Leave on average pay for one month and seven days is granted to Mr. L. S. Ahuja, Temporary Engineer, Salin Canal Division. with effect from 23rd January 1928, or such date as he may avail himself of it.

Leave on average pay for two days is granted to Mr. H. R. Aston, officiating Superintending Engineer, River Training Circle, in extension of the leave grauted him previously.

Mr. W. F. Anderson is appointed as a Temporary Engineer in the Public Works Department, Irrigation Branch, and is posted to the Delta Circle.

On completion of his special duty in the office of the Chief Engineer. Public Works Department, Irrigation Branch, Mr. Kishen Singh, Assistant Engineer, is posted to duty, with headquarters at Rongoon, under the Officer in charge, Rangoon Water Supply and Hydro-Electric Survey.

Bihar and Orissa, February 29, 1928.

Irrigation Department.

Mr. G. Stevenson, Executive Engineer, is granted leave on half average pay on medical certificate for six months, with effect from 9th January 1928.

Punjab, March 2, 1928.

Buildings and Roads Branch.

Mr. G. E. J. Haegert, Assistant Secretary to Government, Punjab, Public Works Department, Buildings and Roads Branch, is granted leave on average pay for one month, with effect from 24th February 1928.

Irrigation Department.

Mr. J. D. H. Badford, Superintending Engineer, 2nd Bahawalpur Circle, Sutlej Valley Project, is allowed leave on average pay for six months, from 22nd April 1928, or subsequent date.

Mr. A. N. Wilson, Assistant Executive Engineer. on transfer from the Majitha Division, Upper Bari Doab Canal, which he left on 28th January 1928, joined the Qaimpur Division, 2nd Bahawalpur Circle, Sutlej Valley Project, on 6th February 1928.

Lala Daya Krishna, Khanna, Executive Engineer, attached to the Dera Nawab Division, 2nd Bahawalpur Circle, Sutlej Valley Project, is allowed leave on average pay for four months and in continuation leave on half average pay for two months, from 15th April 1928, or subsequent date.

Bhai Sikander Singh, Assistant Engineer, on transfer from the Gujranwala Division, Upper Chenab Canal, which he left on 30th November 1927, joined the Sheikhupura Division, Upper Chenab Canal. on 3rd December 1927.

Rai Sahib Lala Mangal Sen, Dhody, Superintending Engineer, Upper Jhelum Canal Circle, is allowed leave on average pay for seven months and five days from 25th April 1928, or subsequent date.

MR. C. E. STOTHERD, M. INST. C. E.

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INDIAN ENGINEERING.

SATURDAY, MARCH 17, 1928.

MR. C. E. STOTHERD, M. INST. C. E.

I.

IN the Jaipur State the name of the late Colonel Sir Swinton Jacob will no doubt long be remembered. He joined the State as engineer in 1867, he served in it for forty-five years without a shadow of friction, and when he retired he left it with the good wishes of everyone from the Maharajah downwards. A Political Agent of his time after a long tour in the districts once wrote to him: "It was delightful to hear the people speak about your work. You are not only serving the Jaipur State well, but all India, by showing what an English-man ought to be, and when he is what he ought to be, what he can do." The Political Agent was referring to Sir Swinton's engineering duties, and as an engineer he was full of energy and enthusiasm. In a State of the magnitude and importance of Jaipur with an area of 15,000 square miles, or about half the size of Ireland, there was a great deal for him to do. He devised and carried out tank irrigation schemes, the water supply scheme of Jaipur city, he constructed and maintained roads, he laid out the public gardens, put up hydraulic cotton presses, settled boundary disputes, helped the Municipal Committee and supervised famine works. But, effective as he was as an engineer, it is probable that little or nothing would have been heard of him by the outside world if he had not also struck out a line for himself as an Indo-Saracenic architect. Jaipur has a typical example of the style of building Sir Swinton Jacob used to design in the Albert Hall; and, the style finding favour mainly by reason of the beautiful details of old Indo-Saracenic art that Sir Swinton employed, he was invited to design buildings at numerous places in India, including the amphitheatres of the two great Delhi Durbars of 1903 and 1912. This is mentioned if only to explain why the work of Mr. Stotherd, who succeeded Sir Swinton Jacob at Jaipur and who proved to be another good bargain for the State, is not more widely known.

Charles Egremont Stotherd, a son of the late Major-General Richard Hugh Stotherd, C. B., Royal Engineers, and grandson of General R. J. Stotherd, Senior Colonel Commandant, Royal Engineers, was born in January 1870, and it was intended that he should follow the traditions of his family. Educated at Charterhouse School in 1883-88, he passed the examination for the Royal Military Academy, Woolwich, in November 1887, but was subsequently disqualified for short sight. It was, however, his wish to be an engineer, and in the autumn of 1888 he entered the Royal Indian Engineering College, Coopers Hill, where he was a student of some distinction. He took the fourth place in the final examinations, receiving the diploma of an Associate of the College and a scholarship in Applied Mechanics, but again failed to pass the medical test for sight. Undeterred by this second disappointment, he succeeded in 1891 in obtaining an Assistant-Engineership on the Bombay, Baroda and Central India Railway, of which Colonel

Sir William Bisset was Agent at that time. He was employed for two years on the construction of the Rajputana-Malwa State Railway and afterwards on the location of the Rutlam-Nagda-Muttra Railway. In 1895, at his own request, Sir William Bisset transferred him to the construction of the latter railway from Rutlam to Nagda, which was completed and opened to traffic in 1896. It was during this period of Mr. Stotherd's career that Sir Swinton Jacob became acquainted with him, and recognising his worth he recommended him as his successor at Jaipur when he was due to retire under the fifty-five years' rule in 1896. The appointment was approved, but when Sir Swinton's retirement date arrived the Maharajah was so reluctant to part with his services that he wished to retain them for a further period. Sir Swinton was willing to remain provided that he would be allowed to absent himself on leave, without remuneration, during the hot-weather, should he so desire; and the Government of India, in view of his past eminent services to the Jaipur State, agreed to this arrangement. Mr. Stotherd was accordingly appointed Deputy to Sir Swinton when he was on duty, and in full charge when Sir Swinton was on leave in the hot season, as he was during three of the subsequent years. On the 9th May 1902, Sir Swinton Jacob finally severed his connexion with the Jaipur Public Works Department to undertake other duties, and Mr. Stotherd then assumed sole charge and remained in it till his retirement on the 24th March 1923, when he had served thirty-two years in India and twenty-seven in the State.

It was while Mr. Stotherd was at Jaipur that railways became for the first time a feature of the work in the State. In 1896 the only railway traversing the State was the Rajputana-Malwa metre-gauge Government State Railway, with a branch to Agra; and in that year His Highness the Maharajah determined to open out the portions of his territory lying to the north and south of this main artery. The country traversed in the southern section falls steadily to the Banas river, and after surmounting a rise over a stony crest near the battlements of Chauthke Barwarra Fort and Palace descends to the plains north-west of the Siwai Madhopur range of forest-clad hills at about 800 feet below the level of the city of Jaipur. Special features of the work were the viaduct of 30 spans of 60 feet girders founded on rock, 1,974 feet in length from face to face of abutments, and 70 feet maximum height over the Banas river, which at this point drains a catchment of 14,000 square miles; and a heavy cutting through a sand ridge a mile in length and 32 feet in depth. The railway is at present laid on the metre gauge, but the whole of the 14 bridges and 56 culverts have their central blocks built to broad gauge dimensions for facility of conversion. The cost of the Banas bridge was Rs. 3½ lakhs, and the total cost of the 73 miles of railway was under Rs. 25 lakhs, or about Rs. 33,000 a mile. The first 32 miles were completed in 1905 and the whole line in October 1907.

On the completion of the southern section railway, Mr. Stotherd was directed to locate and construct a railway through the northern half of the State, a distance of 139 miles. Here, the character of the country is of a different kind. The tract has a sandy soil, with high rocky ranges of hills and peaks and eminences, and it is bisected through the centre by the main range of the Aravallies, of which the highest peak is Raghunathgarh, 3,000 feet above sea level. On the north of this range, the country is mainly a maze of high sand ridges with large areas of drift sand, and the average rainfall diminishes steadily from 24 inches at Jaipur city to about 15 inches at Jhunjhnu in Shaihawati. There are no rock foundations for any of the bridges, and the more important bridges are founded on wells of 16 feet diameter, filled with concrete, and sunk to depths of 40 or 50 feet below the river beds. There are 16 important bridges and 44 smaller bridges and culverts on the line. The ruling gradient is 1 in 200 compensated for the first 50 miles and afterwards 1 in 150 compensated. As on the southern section railway, the architecture of the 15 station buildings conforms to the style of the older and historic structures in the State, and the staff quarters are probably more commodious and better appointed than on any railway of the same class in India. Also, as in the case of the southern section, the bridge-work is constructed to broad-gauge dimensions in the central blocks, and the major bridges are in fact capable of carrying a broad-gauge track without alteration to the under structure. The first section of this railway was opened by His Excellency Lord Chelmsford on the 9th November 1916, a further section was opened in 1922, and up to Jhunjhnu in 1924, at a cost of Rs. 51 lakhs for a length of 106·63 miles. The construction of the remaining section, already located to Loharu in the Panjab (miles 141·38), with its further extension to Hissar is still under consideration.

The Jaipur State has thus at present 180 miles of its own metre-gauge railways, completed at a cost of Rs. 76 lakhs; and, on Mr. Stotherd's advice, the Darbar has in addition secured on very favourable terms a share equivalent to 85 miles of the Nagda-Muttra broad-gauge trunk Government State Railway from Bombay to Delhi, which traverses the south-eastern portion of the State, making a junction at Siwai Madhopur with the Jaipur metre-gauge railway system.

(To be continued.)

BAMBOO AS A PAPER-MAKING MATERIAL.

"THE Indian Forester" of last December has some very pertinent remarks on the national and imperial importance of the bamboo pulp industry. The idea of using bamboo for making paper is not exactly new, more than half a century ago Mr. Thomas Routledge brought the matter prominently to notice, but timber for the manufacture of wood pulp was plentiful and the processes for converting wood into pulp had developed so rapidly that bamboo as a raw material failed to receive the attention it merited. Since then, not once but over and over again, scientists and business people have taken stock of the situation and have prophesied an exhaustion of the world's timber supply. Professor Fraser Story, for instance, pointed out that eight-tenths of the timber of commerce is

soft wood, which among other things is used for pulp. Canada is one of the great suppliers, and the yearly drain on Canadian forests is said to be about 4,000,000,000 cubic feet, at which rate Canada's supply has been estimated to last for twenty-five years. The United States are in the same plight, in fact everywhere forests are being rapidly depleted, and Professor Story estimated that out of a total volume of a million million cubic feet of timber in the world 27½ thousand millions are consumed annually, and the coniferous forests on the globe can last no longer than thirty-seven years. There will be a certain regrowth during this time, but the figure seems certain to be small compared to that of the consumption, and a shortage is bound to come, especially in those areas which are most favourably situated for the market. The less accessible forests mean greater distances, greater transport difficulties and therefore greater expense; the price of wood will rise, and it may rise with alarming suddenness, and lead to a very serious position. "The Indian Forester" gives nearly the whole of the world's supply of pulp for the paper and cellulose industries at about 15 million tons of coniferous wood a year, representing 40 million tons of raw wood; and the normal expansion of paper consumption at about 25 per cent. in ten years. No one, as far as we know, has ever come forward to refute these or similar figures, and the outlook of the future is anything but bright.

Mr. W. Raitt, officer-in-charge of the paper pulp section of the Forest Research Institute, Dehra Dun, an acknowledged expert on the subject, in a paper read before the Royal Society of Arts in London in 1921, said that the question of the world's paper supply had reached an acute stage. Before the war ground wood pulp could be delivered in England at about £6 a ton and chemically prepared pulp at about £10 a ton. The prices have since increased four or five times the above figures, the war has increased the costs of labour, freight, fuel and machinery, and in addition the value of wood for constructional purposes has increased so greatly that the saw-mill is a better market than the pulp factory. Mr. Raitt pointed out that bamboos and some Savannah grasses are economically sound as raw material, and that Burma, Bengal and south-west India could produce 10 million tons of pulp per annum from bamboos, and Assam 3 million tons from Savannah grasses. In other words India could supply sufficient pulp for the requirements of the world. Moreover, while spruce and fir trees take from 40 to 60 years to mature, bamboos and grasses come to maturity in eighteen months. "The Indian Forester" says that the exhaustive investigations carried out at the Dehra Institute have established, both from technical and commercial points of view, that bamboo is *par excellence* a material for paper and other cellulose industries, and that bamboo being annually reproductive there is no risk of the depletion of the economically exploitable areas at any time. In these circumstances it is a little lamentable that India should manufacture only about one-third of the paper she requires, and that with the aid of about 12,000 tons of wood pulp imported annually from other countries. The Empire should surely be self-supporting.

PUBLIC WORKS IN MYSORE.

THE report on the administration of Mysore for the year ended 30th June 1927 gives the final Public Works grant for the year as Rs. 46,72,213, against which an outlay of Rs. 50,57,965 was incurred. There is something refreshing about that statement, usually in the British Governments the engineers are so afraid of exceeding their grants that considerable lapses occur, but in Mysore the outlay boldly exceeded the grant by three or four lakhs, and really why should not it? It would never do of course to make a rule of ignoring a grant, but sometimes it is made too much of a fetish.

Of the Civil Buildings, the most important work under construction was the New Guests' Mansion, Mysore, on which the year's outlay was Rs. 3,21,877. Two Maternity Hospitals, desirable works no doubt, were in course of progress. The State has 2,051 miles of roads, of which 1,613¾ miles are metalled, the average rate of maintenance was Rs. 307 a mile. Not much in the way of new roads was done, though the bridge across the Hemavathi at Gorur was opened during the year. Under Miscellaneous Public Improvements, the outlay on original works was Rs. 2,15,895, mainly on water-supply schemes. A sum of Rs. 5,47,542 was spent under District Funds. The total length of district roads is 3,569 miles, of which 1,754 miles are metalled, the average cost of maintenance was Rs. 126 per mile. An outlay of Rs. 3,81,302 was incurred from the Irrigation Cess Fund, chiefly on the maintenance of tanks, and special attention continued to be paid to the restoration of major tanks, 259 of these works being in progress. A conference of Executive Engineers was held to discuss questions relating to the slow progress of tank works and to arrive at a solution.

The Krishnarajasagara and Allied Works are always an important feature of these annual reports. The Circle has five divisions, and the dam was practically completed, as the masonry was raised to the full height of 130 feet above river bed. The crest of the waste weir was left at 106 above bed, the remaining height of storage, 18 feet, has to be eventually secured by means of automatic shutters. A miscellaneous work in connexion with the dam is a terrace garden in the valley behind the dam for the purpose of affording amenities to the large number of people visiting the dam, a circuit house is also being constructed. The agreement with the Government of Madras entitles Mysore to extend irrigation under the existing river channels to the extent of 33 per cent. over and above what it was in 1920 by improvement of duties, and various schemes to that end are under investigation. Sir M. Visvesvaraya's Committee recommended the desirability of undertaking the North Bank High Level Canal, estimated to cost Rs. 222 lakhs and to irrigate 120,000 acres of land. Sanction to this project has now been accorded.

In its Electrical Department, the Mysore State has always been active. The capital outlay of the year was Rs. 13,88,768, bringing the total capital outlay under this head to Rs. 2,14,14,596. Work was started at

Sivasamudram, Karkanhalli, the Kolar Gold Fields and on the Kolar transmission lines; the remodelling of the Bangalore transmission lines was completed; and with other works the Bowringpet lighting scheme was in progress. The power generated during the year was 151,860,610 kilowatt hours, and the gross earnings were Rs. 39,89,016, giving a cost of 1·137 pies per k. w. h. The total number of installations was 361 for power, 9,905 for lighting and 13 for cooking. The quantity of power consumed during the year was 17,854 H. P. by Mining Companies, 10,967 by Industrial concerns and 3,632 by street and bungalow lighting. The working expenses of the Department, exclusive of depreciation, amounted to 20·69 per cent of the gross receipts.

Under Railways, the Nanjangud-Chamarajnagar line, 22·29 miles, costing Rs. 9,63,045, was opened to public traffic by His Highness the Maharaja. The length of the Mysore State lines, worked by the Madras and Southern Mahratta Railway Company, is 9·88 miles of broad-gauge, and 261·60 miles of metre-gauge, with a capital charge of Rs. 195·97 lakhs. The gross earnings were Rs. 50·60 lakhs, the working expenses Rs. 28·43 lakhs, and the net earnings gave a percentage of 11·32 on the capital outlay. After payment of the guaranteed interest on the sterling loan, the net gain to the State amounted to Rs. 14·77 lakhs, a return of 7·37 per cent. on the capital at charge. The total number of servants employed on the Mysore Railways was 1,154, of which 1,123 were Indians, 28 Anglo-Indians and three Europeans.

RATS AND CULTIVATION IN SIND.

A BULLETIN of the Department of Agriculture, Bombay, on "Injurious Field Rats of Lower Sind and their Extermination" by Mr. P. V. Wagle, M. Ag., and Khan Bahadur Gul Mahomed, A. R., is a well-written and instructive publication. The depredations of certain species of rats have been one of the chief difficulties of rice growers in Lower Sind for many years, and damage to the bajri and wheat crops has also occurred, but the attacks on the rice crop have been persistent in almost every season. A study of the subject was therefore unquestionably called for, and the bulletin gives the information obtained as to the conditions under which the pests live and thrive, as well as the methods used to exterminate the rodents.

There are three species of field rats found in the Lower Sind delta, of which the Sind mole rat, *Gunomys Sindicus*, is by far the most destructive. The general tendency of the rats is to inhabit low-lying land in the vicinity of water. They are locally migratory in their habits and are only found in the rice fields when the crop is actually standing. At such times they suddenly appear in immense numbers, feeding on rice ear-heads, and also on the pulpy portions of the stems before the ears form. They have voracious appetites, and the grain devoured and wasted, and the plants gnawed through and cut while in process of growth, mean in aggregate a vast amount of loss. The extent of the damage varies considerably from year to year, and in a really bad year the devastation is termed a "rat plague." In 1923, a plague year, the rats moved from field to field, cutting off the ear-heads until the fields looked as if they had been harvested. All rats are prolific breeders, and the *Gunomys Sindicus* is no exception, it breeds throughout the year, and the litters may be as large as from 14 to 18 per litter, so that the difficulty of combating the evil can be imagined, especially as the Sind mole rat is an active creature and quick in eluding its pursuers.

In the Western world, in such circumstances, strong action would have been taken long ago, but in Lower Sind the cultivators accepted the affliction as a scourge of God, to be met by prayers and sacrifices, and it was only when the rat plague became very serious that they would awake to the understanding that God helps those who help themselves. Then, they would employ special rat-shikaris, and the rat-killers were quite proficient at the business. A man, when the rats were numerous, would kill sixty to seventy in a day for a payment of from eight to twelve annas per hundred rat-tails produced. Now and then a cultivator, goaded to exasperation, would exert himself, and one cultivator, necessity being the mother of invention, brought under operation a net-and-stick method, whereby he cleared a large area of rats and saved his crops. Dogs, too, are an efficient aid, and British terriers, always enthusiastic rat-hunters, would take great delight in the sport.

Trapping and hand-destruction are not, however, so efficacious on a grand scale as poisoning; and poisoning by means of food in which poison had been introduced and by means of fumigation with poisonous gases was tried. Strychnine hydrochloride, barium carbonate and white arsenic in rat-food have been the subject of experiment, and the first of these gave the best results, though it could not be depended on as a sure means of extermination. Carbon bisulphide, petrol vapour, burning sulphur and tobacco smoke were used as fumigants, and carbon bisulphide was encouraging to some extent; but sometimes the rats were too clever in avoiding the fumes, and sometimes the fumes escaped through the cracks in the soil. Eventually, fumigation was tried on a larger area, 1,600 to 1,800 acres, with carbon bisulphide and calcium cyanide, blown into the burrows with a foot pump, during the months from August to October, when the rats are confined to the field embankments, and the conclusion arrived at was that this method was capable of removing one of the greatest hindrances to successful rice cultivation in Lower Sind.

Notes and Comments.

Tittaghar Sewage Scheme.—Owing to some defects work in connection with this scheme has been suspended for the present. The Tittaghar Municipality is to be entrusted with the work and will make the necessary arrangements for its proper working.

Mr. J. S. Pitkeathly.—It is understood that this official, Chief of the Indian Government Stores Department, has been offered the post of Chief Engineer of the Ceylon Electrical Department, which carries a salary of £3,000 sterling. He has had an interview with the Colonial Secretary in Colombo.

The Port of London.—Lord Ritchie, chairman of the Port of London Authority, speaking at a meeting of the Board on the 10th instant, said that the total net tonnage of vessels which arrived at and departed from the Port of London last year was 52,576,000—an increase of 3,298,000 over the previous year.

Turkish Railway Contract.—The Fox Brothers International Corporation of New York have secured a contract to build 150 miles of railway for the Turkish Government at a cost of 60 million dollars. The contract includes the construction of breakwaters, piers, modern docking and landing facilities at the ports of Mersina and Samsun.

Hooghly Tube Wells.—Owing to the scarcity of water the District Board authorities have been sinking tube wells in the villages within the Sadar and Serampore subdivisions, a sum being provided in the Budget for this purpose. In the Baraset subdivision 476 tube wells have been sunk and sanction has been given for the sinking of 150 more.

A Big Railway Scheme.—The London and North-Eastern Railway has launched a £250,000 scheme with the object of improving the Company's East Anglian service. Twenty new engines and thirty new passenger vehicles have been ordered in addition to the engines and carriages already authorised. The whole scheme is to be completed before the end of the traffic season.

Naihati Municipality.—Work in connection with the water supply extension and the construction of a road over the bridge connecting the eastern and western parts of the town has already been commenced. Several new schemes are being considered and it is expected that the following two will materialise shortly, namely, the opening of a big Municipal Market and the construction of a few necessary roads.

Students' Excursion Train.—In the excursion train which is to be run by the East Indian Railway authorities for students during the Easter holidays the accommodation will be limited, and provision will be made for 200 students. The response has, so far, been very satisfactory, more than 100 students having registered their names. Arrangements are being made for expert guides to accompany the students.

Chittagong Port Bill.—The Council of State on the 2nd instant on the motion of Sir Geoffrey Corbett, agreed to elect a panel consisting of eight members from which six will be selected to serve on the Central Advisory Council for Railways. The President fixed the 7th instant for the receipt of nominations. The Commerce Secretary next moved for consideration of the Select Committee's report on the Bill amending the Chittagong Port Act, 1914. The Council passed the Bill and adjourned.

New Singapore Dock.—The Admiralty have entrusted the contract for towing the new floating dock for the Singapore naval base from the Tyneside to Singapore to the Rotterdam firm of Messrs. Smit and Company. The dock will leave England in June and during the passage through the Suez Canal all traffic will be suspended. The dock will move at the rate of a mile an hour, and is due to reach Singapore in November next.

Mettur Dam Project.—As a result of conversations between the Madras and the Mysore Governments, the latter have agreed to the supply of electric power to this project, at an annual charge of Rs. 4 lakhs for a period of six years, with the option to continue the supply for ten years after the expiry of that period. A special officer is to be placed on deputation to proceed to Mettur for completing the preliminary arrangements.

Dacca Waterworks.—The Waterworks Improvement scheme submitted by the Commissioners of the Dacca Municipality has been approved by the Government of Bengal (Ministry of Local Self-Government). The estimated cost of the scheme is Rs. 4,80,000. The additional estimated cost of maintenance is Rs. 4,000. The sum of Rs. 4,80,000, on account of the cost of the scheme, will be met as follows:—Government contribution Rs. 1,17,000, loan from Government Rs. 1,63,000, and Municipal contribution Rs. 2,00,000

Electrification of Calcutta's Suburban Railways.—Replying to Mr. Suhrawardy in the Council of State, regarding electrification of Calcutta's suburban railways, Sir Geoffrey Corbett said that traffic investigation had been carried out by Major Gordon and Mr. J. N. Roy, and the estimates of the operating costs had recently been revised by Messrs. Merz and Partner. Further revised figures had been called for from them in addition to certain information from the East Indian, Eastern Bengal, and Great Indian Peninsula Railways.

Trans-Persian Railway.—The Geneva correspondent of the "Daily Express" says the Persian representative at Berne has notified the Federal authorities that the Persian Government have decided to construct a railway from Bushire on the Persian Gulf, through Ispahan and Teheran to Amul on the Caspian Sea. This trunk line will run north and south through the middle of Persia and, as measured on the map, will be about 400 miles in length, dividing Persia fairly equally into east and west. Tenders are being sent in by Swiss, British, German and American firms.

Association of Engineers (Bengal).—Reference to the steady progress achieved by this Association during 1927 was made at the annual meeting held in Calcutta on the 2nd instant, when Mr. B. C. Gupta presided. In the course of his address, he stated that during last year, owing to increased activity on the part of the Council and of the members the condition of the Association had materially improved, and the future held out good prospects. New members were coming in who took an active interest in the Association and in the progress of engineering in Bengal. The Association stood for one purpose only—the advancement of engineering in Bengal.

Tanks in Bengal.—The cleaning and re-excavation of tanks is one of the urgent needs for the sanitary and agricultural improvement of rural Bengal, according to the "objects and reasons" of the Bengal Agricultural and Sanitary Improvement (Amendment) Bill, 1928. This short amending Bill is intended to make it perfectly clear that such cleansing and re-excavation of tanks, as well as the construction of masonry and tube-wells is included within the schemes which the Collector and local authorities may take up for the improvement of the agricultural and sanitary condition of Bengal.

Awards to Artists.—The Advisory Committee appointed by the Government of India in connection with the scheme for the decoration of the Government buildings in New Delhi met at Delhi on 5th, 6th and 8th March. It has approved the cartoons submitted by seven out of 24 artists, and in accordance with the announcement made in a communiqué of 23rd December 1927, Rs. 650 is being paid to each of the seven artists whose cartoons have been approved by the Committee. Their names are :—M. V. Dhurandhar, G. P. Fernandez, G. H. Nagarkar, Fyzee, Rahamin, R. D. C. Siodia (Bombay School of Arts), and Miran Bux of the Mayo School of Art, Lahore.

"Burn's Engineering Magazine."—The issue for January 1928 (Vol. XXII, No. 4) is an excellent number in every respect. The editor, Mr. J. R. Sarjantson, is to be congratulated on the brilliant manner in which he conducts the magazine. The articles, etc., from his pen are written in a most attractive style in plain and simple English without any affectation. They are straightforward statements written without fear of captious critics. The romantic history of a great enterprise, namely, that of Messrs. Burn and Company, is most interesting. So also are the articles, etc., on technical subjects. It always affords great pleasure to peruse the pages of this model magazine.

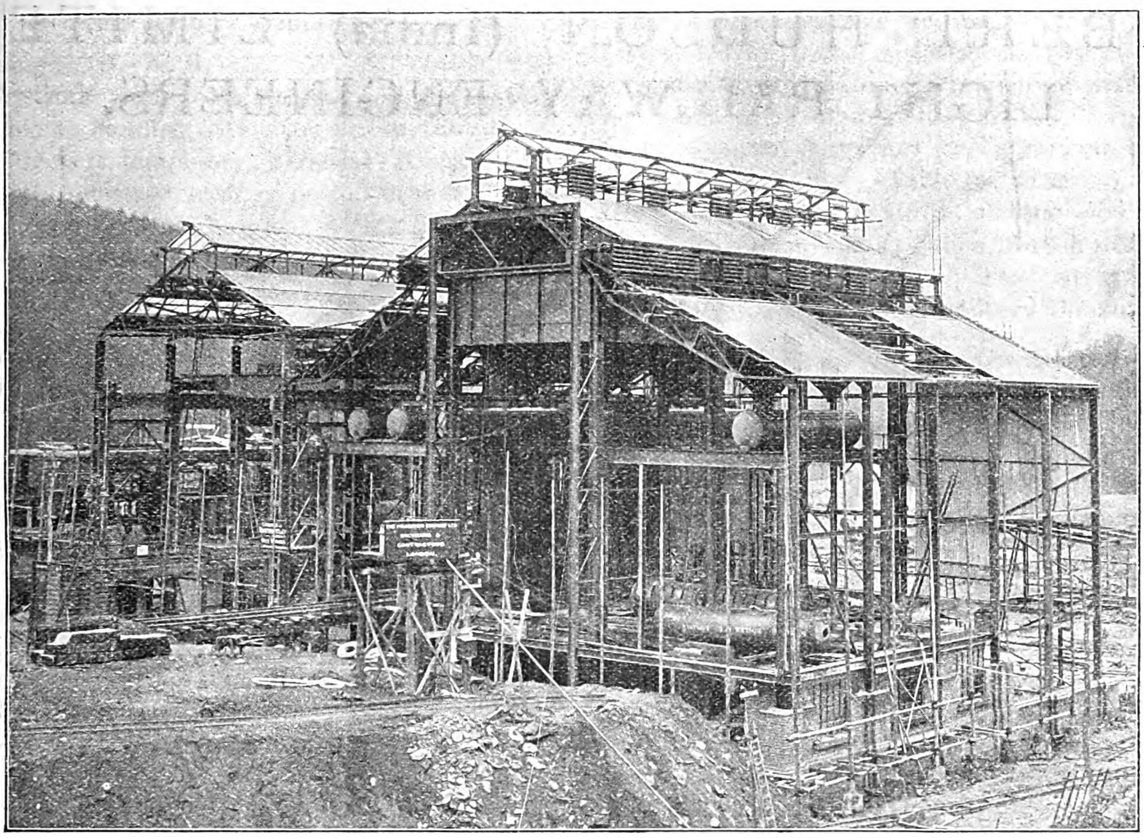
Messrs. Henry Pels.—This celebrated London firm which specializes in the manufacture of modern punches, shears, croppers, notchers, beam benders and guillotines, has issued a beautifully got up and illustrated catalogue of their Guillotine Shears, which is probably the most complete list ever issued by any maker on the subject. At the forthcoming Leipzig Fair the firm propose exhibiting, together with nine other machines, a Guillotine Shear for 10′ 0″ wide plates by 1″ thickness, while among contracts recently executed by the firm was one for a machine to take 10′ 0″ wide plates by 2″ thickness, which, probably, constitutes a record size of electrically driven shears.

Safer Air Service.—A British Official Wireless says that one feature of the Air Minister, Sir Samuel Hoare's statement in the House of Commons recently, that has given much satisfaction, was the announcement that the air service is becoming safer. Two devices with which service machines are now fitted are mainly responsible for this improvement, which is evidenced by the fact that the number of fatal accidents in relation to the hours flown was last year the smallest on record. These are the equipment of airmen with parachutes and the fitting to service 'planes of slotted wings—a British invention for preventing "stalling" which now has a world-wide reputation. He claimed that the Air Force had the world's highest average standard of technical efficiency, whether in engine performance or in metal fuselage construction.

Indian Wagon Industry.—Some radical alterations have been made in the Steel Protection Bill by the Select Committee, whose report has been made available, along with two dissenting minutes, of which one is by Sir George Rainy. The Committee do not feel justified in agreeing to the proposal of the Government that the present revenue duty of 10 per cent. on wagon and underframes should be raised to 17 per cent. They think it advisable to maintain the existing revenue duty, and do not think that any case has been made out for the proposed further duty of Rs. 15 per ton on wagons and underframes of non-British manufacture. As for the 3 per cent. protective duty on wire and wire nails, the Committee see no reason for departing from the recommendation of the Tariff Board that the duty should be discontinued. The Committee state that their reason for rejecting the Government proposals is that the measure of protection proposed in the Bill is in excess of the recommendations of the Tariff Board.

Cochin Harbour Improvement.—Further progress has been made in the Cochin harbour works. The channel across the bar has now reached deep water on the harbour side and there remains only the dredging of a mile of channel in soft mud on the seaward side in order to complete the work for this season—that is, by the end of this month. The dredging on the harbour side of the approach gave much more trouble than was anticipated. At times the revolving cutter could be heard grinding on the rock-like sand for a distance of over three miles. It was only possible to keep to the programme date for the completion of this section by exceeding still further the estimated number of pumping hours ; and the contingent operations were managed so well that in two succeeding weeks the ship actually pumped for nearly 90 per cent. of the whole time available, day and night—a remarkable performance for this class of work in the open sea. The rapid wearing of the pump gave considerable anxiety to those in charge, but by effecting temporary repairs at week-ends, the engineers were able to control the situation. It is hoped that the mud dredging now begun will not affect the pump appreciably.

Anglo-Egyptian Draft Treaty Rejected.—Sarwat Pasha on the 4th March informed Lord Lloyd, the British High Commissioner for Egypt, that his Cabinet have refused to accept the draft Anglo-Egyptian Treaty which Sir Austen Chamberlain and he had negotiated, as it was incompatible with the independence of Egypt and recognised the right of the British Government to maintain troops in Egypt. It was on the point of maintaining British troops in Egypt that the negotiations of four years ago between Mr. Ramsay MacDonald and Zaghlul Pasha broke down. Sarwat Pasha's Ministry has resigned. Since the conversations in London with Sir Austen Chamberlain, last summer, Sarwat Pasha has been trying to obtain sufficient support to withstand the Nationalist attack, which was anticipated against some of the clauses of the proposed Treaty, especially that relating to the British military occupation for a further period of 10 years. The newspaper "El Ahram" thinks that the question of military occupation should be referred to the League of Nations. In an interview granted by Sir Austen Chamberlain, on his way to Geneva, to Reuter's representative, the Foreign Secretary said that British relations would continue to be regulated by the Declaration of 1922. The police



dispersed student demonstrators in the neighbourhood of Wafd headquarters. Zaghlul Pasha's widow exhorted them to return to their studies.

Staff Changes, B.- N. R.—Mr. W. B. Purkis, 2nd Personal Assistant and Joint Secretary to the Agent, having completed handing over charge of his duties to Mr. A. W. Beckett, temporary Personal Assistant to Agent, on 29th February 1928, is posted to the Traffic Department to take over charge as Acting Superintendent, Catering and Advertising, from Mr. O. F. Argles, Superintendent, Catering and Advertising, proceeding on leave. Mr. G. Cunningham has taken over charge of the Locomotive, Carriage and Wagon Department, from Mr. H. L. Cole, as Chief Mechanical Engineer, with effect from 28th February 1928, and the latter officer has proceeded on 28 months' leave prior to retirement, from 29th February 1928. Mr. C. S. Moore, Assistant Traffic Superintendent, attached to the office of the Transportation Manager, has proceeded on eight months' combined leave. Mr. P. O. Bingham, Head Train Controller, Khargpur, is transferred to the office of the Transportation Manager and promoted to act as Assistant Traffic Superintendent *vice* Mr. C. S. Moore. Mr. G. F. FitzGerald, Assistant Transportation Officer, Waltair, is transferred to Chakardharpore. Mr. S. C. Tapsell, Acting Assistant Transportation Officer, Chakardharpore, is transferred to Khargpur. Mr. W. K. Orton, Assistant Transportation Officer, Khargpur, is transferred to Khurda Road.

Long-Range Reception.—In spite of the difficulties encountered, long-range wireless reception is a very fascinating hobby, particularly to those who are far from their own country, and there is little doubt that the new system of high frequency amplification recently introduced by the advent of the Marconi Shielded Valve will cause revolutionary changes in long-distance receivers, for it is rapidly coming into favour with the "ether searchers." The principle of overcoming the inter-electrode capacity and shielding each H. F. stage completely allows of the use of three stages of H. F. magnification with absolute stability. It is a comparatively simple matter to obtain a magnification of 30-35 per stage, giving an overall amplification of 30,000 before the detector valve! And this is without reaction, so that the quality of reproduction is truly astounding, distant stations being as clean-cut and intelligible as the local transmitter—providing, of course, that heterodyne or atmospheric disturbances are not excessive, as they are beyond our control. One very interesting receiver embodying this new valve is a six-valve set with a frame aerial less than 1 foot square, on which it is possible to log nearly every European station. This is only available in complete form, but the Marconiphone Co., of London, are also issuing constructional books of a long-range five-valve receiver of outstanding performance.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 1st March 1928 :—Messrs. William Jacks and Co., Karachi—3 sets Concrete Mixers, capacity dry mixture per batch 14 cubic feet, concrete per batch 10 cubic feet, with 7½ b. h. p., 925 r. p. m. motor, Rs. 13,980 free delivery at Jhansi railway station by 9th May 1928, at site; Messrs. Turner, Hoare and Co., Ltd., Bombay—1 Lathe, high speed, self-acting, sliding, surfacing and screw cutting, 3⅛-inch diameter 4-jaw independent chuck, complete with fittings and 15-inch diameter 3-jaw centring scroll chuck, Rs. 4,795 free delivery at Dera Nawab railway station by 21st May 1928; Messrs. The AEG (India) Electric Co., Bombay—1 Switchboard consisting of three incoming feeder panels, Rs. 13,070 free delivery at Barakhamba railway station by 30th June 1928; Messrs. Martin and Co., Calcutta—185 cwts. Sheets, corrugated steel, galvanised, 24 gauge, "Staley Crown" brand, Rs. 2,313 f. o. r. Howrah; 200 cwts. Rounds, M. S., ½-inch, Rs. 1,600 f. o r. Howrah; 150 cwts. Rounds, M. S., ⅝-inch, Tata, Rs. 1,162 f. o. r. Howrah; Messrs. Jessop and Co., Ltd., Calcutta—70 cwts. Sheets, corrugated, galvanised, 24 gauge, British, Rs. 1,109 free delivery Lahore Cantonment; 220 cwts. 56 lb. Beams, R. S., British, Rs. 2,729 free delivery Bhakkar.

The Longevity of British Commercial Vehicles.—The series of parades of commercial motor vehicles held in London, and the principal industrial cities during the year not only serve their primary purpose of encouraging owners and drivers of these vehicles to maintain them in well kept and mechanically efficient condition, but also demonstrate how successfully these heavy types of vehicles by the best British manufacturers stand up to their work. One of the largest British users of motor transport are Messrs. Lever Bros., and their subsidiary companies, who were successful in winning the Challenge Cup at the Preston Motor Vehicle Parade with two of their Thornycroft vehicles, which were adjudged to be the best pair in their class. Both were Thornycroft vans which had been purchased as reconditioned ex-war-service vehicles in 1920 and had since completed well over 90,000 miles. Altogether Messrs. Lever Bros.' Transport Department have won 10 awards with their Thornycroft vehicles at these parades, including the 100 guineas Dunlop Challenge Trophy they won at the Birmingham Parade in 1925. It is not surprising that one of the first orders John I. Thornycroft and Co., Ltd., booked at the Olympia Show was on behalf of Lever Bros., Ltd., for 36 of the new type "JJ" 5-ton Thornycroft chassis, which will increase the Lever Bros.' transport fleet to well over 200 Thornycroft vehicles of different carrying capacities.

Nag Hamadi Barrage in Egypt.—The ceremony of laying the foundation stone of the proposed new Nile Barrage at Nag Hamadi, 100 miles south of Assuit, was performed by King Fuad in the presence of the Ministers and the Diplomatic Corps. The barrage will provide irrigation for an area of 500,000 acres in Middle Egypt, converting basin irrigation into perennial. The work is estimated to cost £E 2 millions and will be completed by 1930. The contractors are Sir John Jackson, Limited, and Ransome Rapier, Limited, who are providing the gates and gearing. Three projects have been prepared for raising the Aswan Dam in order to double the capacity of the reservoir to provide water for the dwindling irrigation of Egypt, owing to the operations of the Sudan on the Blue Nile at Makwar. It is suggested that these schemes be submitted to an international commission for advice. Going to the White Nile for storage for Egypt is at times hinted at, but it is highly improbable that such an idea will be seriously entertained, unless Blue Nile supplies of water and silt can be diverted to and secured in the White Nile basin immediately above the confluence at Khartoum. There is no silt in the White Nile, and even the water stored would be mostly evaporated before it could reach Egypt proper. What Egypt requires is to prevent tampering with Blue Nile supplies upstream and additional reservoir capacity on the Main Nile in or as near as possible to the areas requiring additional supplies of water and silt.

Current News.

A WEEKLY air mail service between London, Delhi and Calcutta is contemplated within a year.

MR. S. F. W. POWELL, Deputy Harbour Master of Calcutta, is going on long leave from 18th March preparatory to retirement.

THE total approximate gross earnings of State railways up to 25th February 1928 amounted to Rs. 92·59 crores, or Rs. 394 lakhs more than the figures for the corresponding period of the previous year.

WITH slight modifications, the Bengal Legislative Council on Wednesday last passed the Irrigation Budget amounting to Rs. 54,93,000.

IT is officially announced that the headquarters of the Director-General of Observatories will be moved from Simla to Poona from 1st April 1928.

A NEW plant for the manufacture of sulphate of ammonia, to the extent of 100,000 tons a year, by the Fauser process, is to be put up at Willebroeck, Belgium.

WHEN the new extensions of the Norwegian Norsk hydro-electric plant have been completed, there will be an annual exportable output of 900,000 tons of nitrogen.

THE B. B. and C. I. Employees' Association was formally recognized on 8th March by the Agent of the Railway at a conference which he held with the officers of the Union.

CAPTAIN HINCHLIFFE, whose plans for a non-stop flight to India were recently featured in the newspapers, left Carnwell aerodrome on the morning of 13th March for an unknown destination.

THE London Board of Trade returns for February show that imports amounted to £98,898,374 and exports to £57,236,148, representing reductions of £1,540,851 and £2,506,585, respectively, compared with January.

OVER 23,000 people inspected the "Royal Scot" engine, the type that hauls the world's record non-stop train, on exhibition at Manchester recently. Manchester thus has the record attendance amongst the 14 towns the "Royal Scot" has so far visited.

THE total approximate gross earnings of State railways for the week ending 25th February 1928 amounted to Rs. 227 lakhs, Rs. 6 lakhs more than the figures for the last week and Rs. 17 lakhs more than the figures for the corresponding week of the previous year.

A £800,000 contract to extend the pulverised fuel plant of Synthetic Ammonia and Nitrate, Ltd., Billingham (on Tees), has been placed by Imperial Chemicals with International Combustion, Ltd., Kingsway. Dorman, Long and Co. will supply 20,000 tons of iron and steel work.

THE Railway Board have sanctioned the construction by the agency of the South Indian Railway of a line of railway of 5 feet 6-inch gauge from Salem to Mettur Dam *viâ* Macheri, a distance of about 26·80 miles. The project will be known as the Salem-Mettur Dam Railway.

ON 13th February the Chicago and North Western Railway announced that a system of automatic train control, costing £600,000, is to be installed for a distance of 500 miles from Chicago to Omaha, and that this will be the longest stretch in the world over which such a system will be in operation. It is expected to complete the work by 1st May.

A DEPARTMENT of agricultural engineering has been established at the Ontario Agricultural College at Guelph—superseding the former departments of Physics and Manual Training—with a view to teaching the farmers the advantages accruing from the use of modern machinery. The courses of the new department include petrol engines, electricity, forging, hydro-electric power on the farm and rural sanitation.

WHAT will rank as one of the longest bridges on the whole of the African Continent is about to be constructed across the river Benue at Makurdi, 290 miles inland from Port Harcourt on the Eastern Division of the Nigerian Railway. The bridge will comprise thirteen spans with a total length between abutments of 2,584 feet. The contract for the whole of the works has been awarded to Sir William Arrol and Co., Ltd., of Glasgow.

THE constitution has been sanctioned of a temporary Independent Subdivision in the P. W. D., Burma, Irrigation Branch, to be known as the Tharrawaddy Independent Irrigation Subdivision in the River Training Circle with headquarters at Tharrawaddy. The Subdivision will comprise all works in connection with the construction of the Sidaing Irrigation Tank and Irrigation Channel in the Thegon Township, Prome District.

A NEW building of 35 storeys in height is under construction in New York for the New York Central Railroad, an unusual feature of the building being that two busy streets run through it. The tracks of the New York Central and New York, New Haven and Hartford railways pass through the basement. The main structure of the building will be 15 storeys in height, and the imposing tower another 20 storeys. Altogether 40 lifts are being provided.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

DETERIORATION OF CANAL LANDS.

SIR,—"Fifty years ago" the "Pioneer" reported that the Government of the North-West Provinces (United Provinces now) appointed a committee to enquire into the causes that led to the deterioration of certain lands of Aligarh District, which were beginning to suffer from "reh." It is mentioned that 20 years prior to 1878 a similar enquiry had been held in the Districts of Panipat and Karnal on the Western Jamna Canal tracts. The paper suggests that, as the injured lands in the Aligarh District lay between two branches of the Ganges Canal it may be presumed that there is some connection between canal water and "reh."

Seventy years is a long time for us to arrive at the present stage of our knowledge of these questions of saline efflorescence and waterlogging, and we are still not so far advanced as to be able to restrict ourselves and to provide safeguards in keeping down irrigation intensity, avoiding excessive raising of canal water levels, constructing deep drainages and so on in our Punjab Canal areas. We have always committed the selfsame faults through greed in the use of the river supplies. We have brought about our troubles and then set to work to rectify matters, often when it is too late. Cutting down supplies on established canal areas is always difficult. But, where the disease has got a hold and is progressing, drastic measures must be adopted, in spite of the fall of canal revenue which must result, and the discontent of irrigators.

While trying to cure the existing canal areas, are we preparing to infect the new Nili Bar by providing it with perennial irrigation? I think we are. A short and merry life to the Nili Bar can be safely predicted!

BACCHUS.

Literary Notices.

The Principles of Electric Power Transmission by Alternating Currents.—By H. Waddicor, B. Sc., A. M. I. E. E., A. A. I. E. E. London: Chapman and Hall, Ltd. 1928. Price, 21s. net.

The author, in his preface, writes:—There appears to be a need for a suitable textbook for use by students pursuing a course of study in Electric Power Transmission at Universities and Technical Colleges. This book is intended primarily to meet this need, but the practical side has been kept in view, and it is hoped that the subject matter will also be of direct utility to designers and those engineers responsible for the operation of power transmission systems. It is not claimed that anything novel is presented herein, but rather that the work is a systematic exposition of the principles underlying the electrical design of transmission lines, and contains in a complete and concise form results hitherto recorded in a very scattered literature. In the treatment of the subject familiarity with the use of complex quantities is presupposed, as a general course in alternating currents can hardly be considered complete without a discussion of this method of calculation. A knowledge of hyperbolic functions is an advantage when reading Chapter V., but the hyperbolic method of solution can be readily used for the solution of problems without this knowledge in the same way as tables of logarithms can be efficiently employed without understanding their theory or method of derivation. Wherever possible fully-worked numerical examples have been introduced in order to clarify the subject. It is not suggested in connection with the exact mathematical methods of solution that these should be used for all line calculations. In actual practice charts and monograms are often used to determine line constants, regulation, etc., and probably furnish results to the degree of accuracy warranted by the state of knowledge of the data of the problem. This however, does not detract from the importance of more rigorous methods, and there are many problems which cannot properly be solved without their assistance . . . . The art of the designer is to know when to calculate and when to use the more approximate methods. The book is demy 8vo., 419 pages, and is fully illustrated. It will be found a valuable addition to the library of all engineers who are engaged in electric power transmission.

INDIAN ENGINEERING.

Addresses and Changes of Addresses.

In requesting change of address give **old** as well as new address and write legibly.

The full and correct address should always be given on **Money-Order Coupons**—see instructions thereon.

Foreign Notes.

General Railway Station, Mukden, Manchuria.—Through communication for passenger and goods traffic between the Pekin-Mukden and Mukden-Hailung Railways, was inaugurated on 19th December last. In order to facilitate further developments, it has been decided to build a large new general railway station at Mukden, at an estimated cost of $450,000. The contract, we understand, has been awarded to a German firm, and that the work is to be completed in two years.

Navigation Signals.—A new system of signalling which, it is claimed, is likely to render the same service as the Loth cable for navigating ships into harbour during fog, has been experimented with for some time past at Havre. The inventor, M. Aicardy, a naval officer, employs two emission aerials, whereby two bands are made to overlap each other and neutralise effects in such a way that a "zone of silence," representing the width of the navigable channel, is created between them. A receiver on the ship shows by characteristic sounds when the vessel is moving away from the channel and the sounds increase in intensity with the distance, so that it is easy for the pilot to keep to the safe route. The signals are heard at a distance of from five to six miles.

Water Supply for Cordoba.—Work has begun on a new potable water supply system for the town and suburbs of Cordoba, estimated for an eventual population of 150,000. Cordoba, one of the most important towns of Argentina and the centre of a rich agricultural and cattle country, stands 1,440 feet above sea level on the right bank of the Rio Primero at 432 miles from Buenos Aires. The contract calls for two tunnels through the hills, one 1⅞ miles and the other five-eighths of a mile long; several dams at Calera at 7½ miles from the town; and a modern filtering and sterilising plant at Alta Alberdi. Covered conduits will be used for conveying the water to and from the filtering plant. The estimated cost of the undertaking is between 5,750,000 and 6,000,000 pesos (paper).

Harbour Works in France.—In view of the preparations being made by shipbuilders on the Loire for building much larger vessels than those now constructed there, it has been found necessary to provide for the passage of bigger ships from the Loire to the port of Saint-Nazaire, where they will be fitted out. A dock, 350 m. long and 50 m. wide, will be constructed, and it will serve the double purpose of enabling the biggest vessels to pass between the Loire and the port and of being used as a dry dock in case of necessity. Railway communication will be provided between the two sides of the dock by a swing bridge passing over one of the sluice gates. The estimated cost is about 80 million francs, which, it is expected, will be partly covered by material obtained from Germany on account of reparations.

Submarines for the British Navy.—It is reported, that contracts for the construction of four additional submarines of the "O" class have just been placed with Messrs. Vickers-Armstrong, Limited, Barrow-in-Furness, and for another boat of the same class with Messrs. Cammell Laird and Company, Limited, Birkenhead; a sixth boat is to be laid down at Chatham. These vessels were provided for in the 1927 Estimates, and are additional to those of the previous year's programme, of which three are already building by Messrs. Vickers-Armstrong, Limited, at Barrow, and two by Messrs. William Beardmore and Company, Limited, at Dalmuir. It will be remembered that the first vessel of this class, the "Oberon," was completed at Chatham last year, and another one, the "Odin," is already under construction at that yard. The "Oberon" has a surface displacement of 1,345 tons and a submerged displacement of 1,750 tons.

Annual Parade of Motor Lorries.—The twenty-second annual London parade of commercial motor vehicles organised by the Commercial Motor Users Association (Incorporated), with the object of encouraging drivers to take a personal interest in the driving and condition of their vehicles, and to run them without accident, will take place on Saturday, 31st March, under the patronage of His Majesty the King. The Commercial Motor Challenge Cup will be awarded to the owner whose "team," in the opinion of the Judges' Committee, is in the best condition, having regard to the class of work upon which the units are employed, the ages of the machines, and the total distance run by them. The drivers of the winning team will receive the Shrapnell-Smith Challenge Cup, and each driver will be given a cash award and a souvenir medal; the driver of each vehicle of the "runners-up" team will receive a cash award and a souvenir medal; the drivers of the third to the thirteenth teams, inclusive, will receive a cash award, or will be highly commended.

The Seine Floods.—One of the original proposals for preventing inundations was to construct a canal between the Marne and the Seine to the north of Paris, but the expense was so great that the scheme was abandoned, especially in view of doubts that were expressed as to whether the canal would be really effective in facilitating the flow of water from above to below the city. The same objection is being made in some quarters against the utilisation of the Saint-Maur Canal for the purpose, but the technical commission believes that there is no ground for the protests being raised against the scheme by the local authorities on the Marne, and it has been decided to start work this year upon deepening the Saint-Maur Canal and joining it up with the subterranean canal at Joinville. This latter will be widened to 9 m. and deepened by 3 feet, while the Saint Maur Canal will be deepened by 3¼ feet. As this canal cuts off the bend of the Marne, it is estimated that it will reduce the water level at Joinville in times of flood by about 3 feet. The canal also will be rendered navigable for big barges, for which purpose an extension lock will be constructed.

Aerial Survey on the Rhodesia-Congo Border.—In making preparations for an aerial survey of a concession on the Rhodesia-Congo Border, aerodromes were made and emergency landing places cleared, according to the "S. A. Mining and Engineering Journal," at intervals of 20 miles apart, to ensure the safety of the pilots and photographers. Two aerodromes were constructed, one at N'Changa and one at Lunsemfwa. At the former place a steel and galvanised iron hangar to house two 'planes was erected and a special building for the development and printing of the photographs. Houses for the personnel were also built. The preparation of the emergency landing places proved to be more difficult than was expected, owing to the ubiquity of the giant ant heaps that are such an amazing feature of the country. The removal of these obstructions proved much more difficult than clearing away forest trees. Forty-three of these landing places were prepared and many of them had to be cleared a second time before the actual flying began, owing to the rapid growth of heavy grass, which is even more dangerous to landing aeroplanes than many other obstructions, because it entangles the wheels and causes the 'planes to somersault. The provision of forty-three landing places made it possible to photograph between 10,000 and 12,000 square miles.

An American Locomotive Innovation.—According to the "Railway Gazette," in order to meet the very difficult conditions prevailing in a heavy duty hump yard, at Dupo, Illinois, the Missouri Pacific Railway has adopted a new principle for increasing the power of locomotives engaged in shunting service. One of the engines is a Mallet compound with the 2-8-8-2 wheel arrangement, whilst the other is of the 2-10-2 type, with fixed wheelbase. A novel feature about these locomotives is that each is fitted with a high capacity tender supported upon two six-wheeled bogies, four wheels in each case being power-driven by engines of the booster class, thus introducing a double power-driven tender with a very greatly added tractive power. The hump yard is used in connection with the Southern Illinois coal-mining district, and is subject to peak movements over long sustained periods during the coal-loading season. The north-bound movement over the hump consists of heavy coal trains from the south, and the gradient in this direction ranges from 0·17 per cent. at the foot to 2·2 per cent. at the apex of the hump. The south-bound movement consists of merchandise loadings and empty coal cars for the south, and the gradient here ranges from zero at the foot to 2·3 per cent. at the apex. In one case the tractive power of the locomotive has been raised by 28,000 lb., and in the other by 30,000 lb., by the addition of the double power-driven tenders.

Railways and Concrete.—In a communication to the "Railway Gazette" from an engineer having considerable experience of the application to railway purposes of ferro-concrete, it is pointed out that one of the chief reasons for the general adoption of this material with particular reference to pre-cast units has been the high cost of timber. The war brought about a very serious shortage and created a real need for a substitute; but even prior thereto timber costs were already high, and the alternative was found in reinforced concrete, whilst further, owing to the shortage, timber of inferior quality has had to be used in recent years in order to meet requirements, such timber obviously being less economical owing to its shorter life. One of the outstanding advantages of concrete for railway purposes is its greater durability, for when properly manufactured and matured, it is proof against climatic conditions, improving rather than deteriorating with age, and for this reason it is specially suitable for all types of posts, of which railway companies use enormous quantities. Timber posts, on the other hand, decay, particularly at the ground line, in some instances in a few years, whereas concrete is unaffected and permanent, a considerable saving in annual maintenance being thereby effected. The adaptability of this material to a variety of uses is always increasing, and nowadays some very heavy units are manufactured in accordance with the ferro-concrete principle.

Iron and Coal in Argentina.—A recent report of the Argentine Department of Mines and Geology states that there are no known iron-ore deposits in the country which could be worked on a commercial basis. The largest known deposit only covers an area of about 900 square metres, where the ore is poor in iron content and would require excessive quantities of coke for smelting; magnetic or mechanical treatment is not feasible, also transport alone of the iron to Buenos Ayres would cost more than half the price of imported iron. It is further considered that the importation of iron ore for local smelting would not be profitable on account of the absence of native coal. The small coal deposits known to exist contain a high proportion of ash and sulphur and are situated at prohibitive distances from the consuming centres. The conclusion reached is that, as far as can be seen, the country must depend on imported iron for its requirements, and that consequently an iron and steel industry cannot be developed in the Argentine on any scale approaching that of other countries producing pig-iron. However, in order to meet local requirements to a greater extent, the use is recommended of scrap. It is estimated that about 60,000 tons of such iron are available each year, and that the supply will increase as the rails imported during the years 1904-13 will shortly need renewal. The export of scrap was prohibited during the years 1918 to 1923, and it is recommended that exports should again be prohibited and, further, that the small duty on the importation of pig-iron should be removed.

The Development of the St. Lawrence.—The Joint Board of Engineers (American and Canadian) appointed to consider the problems connected with the development of the St. Lawrence, for navigational and hydro-electric purposes, has issued a voluminous report. A report submitted to the International Joint Commission in 1921, is first dealt with. This showed that the development of nearly all the potential power (about 4,000,000 h.-p.) could form a co-ordinate part of the schemes for the improvement of navigation. The simultaneous development of the power was, however, not considered economical owing to the lack of a market for it. The present report states that sound business management will dictate the initial installation of only a part of the hydro-electric plant. With a total initial installation of 1,368,000 h.-p., the costs, including all features required for navigation, and with complete channel enlargement for winter power operation, would be respectively $350,000,000 and $385,500,000. The plans presented by the Board outline the subsequent complete development of the river by the construction of additional power works, with an installed capacity of about 2,500,000 h.-p., at an additional cost of approximately $225,000,000. The total ultimate development visualised by the Board, therefore, amounts to about 5 million h.-p., at a total cost of from $620 to $650 millions, including navigation works. It is considered that it will be necessary for the Governments to supervise the operation of power works to prevent the river water levels being seriously affected.

General Articles.

SAND-LIME BRICKS.

OF particular interest to India is the sand-lime brick process, especially as skilled labour is not required, and the rapid production of very high grade bricks is not bounded by difficulties such as finding suitable deposits of clay, often also with months of weathering required. Considerable progress is now, however, at last being made with the same lime brick process in Great Britain, and two important new plants are in operation at Mansfield, near Nottingham, each with a capacity of 100,000 to 120,000 bricks per week, based on one shift per 24 hours or twice this for two shifts, easily worked, one for the Standard Sand Co., and the other for the Mansfield Sand Co. These have been supplied complete by Messrs. Sutcliffe Speakman and Co., Ltd., of Leigh, Lancashire, who also have an installation on hand for Bournemouth. Altogether they have over 12 plants at work in Great Britain representing about 1,250,000 bricks per 24 hours.

The sand-lime brick process was introduced in 1894, and consists essentially in mixing sand (silica) intimately with 5-10 per cent. of thoroughly slaked lime, according to circumstances, forming this into a semi-dry mass with water, passing it through a brick moulding or pressing machine, and then heating the brick shapes for a number of hours between 4-10 in closed iron cylinders by blowing in steam under a pressure of, say, 120-180 lb. per square inch, corresponding to a temperature of not less than 350° F., the exact time depending on the pressure. Under these circumstances part of the sand (silica) combines with the lime and results in the formation of hydrated calcium silicates, which bind the whole mass together, forming an intensely hard, close-grained, and homogeneous brick. The same principle is also applicable to the manufacture of large building blocks, slabs, and paving stones, while material such as ash and clinker, and blast furnace slag can be used in place of sand.

The process, as indicated, is far superior to the ordinary burnt clay methods, being for example cheaper in most localities, while the whole operation can be carried out complete from the raw material to the finished bricks in 24-36 hours, and if necessary the bricks can be used direct, hot out of the steaming process.

The high quality of the sand-lime brick has been proved by means of every chemical, mechanical, and physical test to which bricks can be subjected, and it may be stated the British Standards Association has drawn up a standard specification for them (No. 187, British Engineering Standards Association, 28, Victoria Street, London, S. W. I, price 1*s.* 2*d.* post free.)

Thus they possess greater resistance to crushing strain than ordinary burnt bricks, and they are less absorbent to water, with equal porosity to the air, whilst a fact of great practical importance is that every brick is a "facing" brick. That is to say they are all perfectly true, straight, and of equal size, with no sign of twisting, bulging, or distortion, quite different from the burnt clay brick. Again they are specially pleasing and Artistic in appearance, with a fine smooth grain—the colour depending on the sand used, being generally pale yellow, stone coloured, or grey with a pinkish cast, and a building constructed with them has a particularly distinctive look, because of the combined effect of the fine appearance of the bricks, their uniform size, and the very thin line of mortar required on this account.

The only requirement is that the lime should contain not even the slightest trace of unslaked lime (quicklime) as shown by Mr. E. R. Sutcliffe, one of the pioneers of the process, and the plant is arranged so that the mixture of sand and ground quicklime is slaked by means of efficient mixing appliances, combined with a sufficiently long storage.

A typical example of a modern Sutcliffe Speakman sand-lime brick plant on the latest high-pressure steam principles is at Littlehampton in Sussex, belonging to the Arun Brick Co., Ltd., having a capacity of 110,000-120,000 bricks a week. In this case the quicklime is first crushed and then ground to a fine powder, equivalent to all through a 50-mesh screen. Afterwards it is mixed in the proportion of about 5-10 per cent. with the sand, the product passed through a horizontal differential mixer and allowed to lie for at least 12 hours in a silo or store bin.

The natural moisture in the sand slakes the finely pulverised quicklime in the most effective fashion, essential to the success of the process, as indicated, and subsequently the mixture is fed by means of a band conveyor through a double deck mixing mill to a powerful "Emperor" duplex press or moulding machine. In this, for ordinary bricks, the product is compressed into the usual shape, 9 inches long by 4⅝ inches square section, at a pressure of 2 tons per square inch, equivalent to about 90 tons on each brick. The machine is driven by means of a belt, and has a horizontal rotary table through which at one end the brick shapes come up to the rate of nearly 40 per minute, these being lifted off by hand in pairs. They are then stacked on small wheel trolleys each of which holds about 300 bricks, and 12 of these trolleys, one behind the other, that is 3,600 bricks, are run into a long steel "boiler" or autoclave, in the shape of a long cylinder. This is closed at each end by means of a heavy circular door secured by nuts and bolts, and at Littlehampton the steam is blown in for four hours at 165 lb. pressure per square inch, corresponding to a temperature of about 370° F. from a steam boiler. The steam is then shut off, the door opened, and the trainload of 3,600 bricks run out ready for use almost immediately, as mentioned, whilst the next load is waiting for treatment. If lower steam pressure is used, say 120 lb., the only difference is that longer heating is necessary, for this particular about 6 hours.

Finally, it may be mentioned another interesting plant is that at the South Bank works of Messrs. Bolchow Vaughan and Co., Ltd., of Middlesborough, using blast furnace slag, while an important new apparatus just introduced by Messrs. Sutcliffe Speakman is a patent brick loading grab which will handle 30,000 bricks an hour, with two men only as compared with usual hand methods of 1,000 bricks per man per hour.

THE KENNEDY FORMULA.

III.

BUT Kennedy's paper in Vol. CXIX of the Civil Engineers, discloses a totally different state of affairs in the Bari Doab Canal of his day (page 281).

(*i*) The channels had assumed permanent sections by silting or scouring.

(*ii*) All the sites discussed had, however, silted beds often 2 or 3 feet deep, deposited during many years of steady flow.

(*iii*) Each such section was stabilised, that is, no further scour or deposit occurred.

(*iv*) Invariably the form of section thus arrived at was nearly rectangular, the sides being vertical and of fine sediment, and the bed horizontal and of coarser sand.*

These statements are positive, and with an observer of Mr. Kennedy's type, are not to be disputed.

* It is respectfully submitted that Kennedy's V_0 were all too high, because it seems obvious all these sections are cleaned sections (*i. e.*, on the point of scouring) Since no colloidal matter can be deposited, the percolation must be high also.

The actual results, as so stated, are tabulated :—

TABLE C.

No.	Rectangular Sections.				No.	Rectangular Sections.			
	Obs. v	x	f	m		Obs. v	x	f	m
1	2·86	36·4	2·576	6·01	13	2·25	22·5	2·370	3·79
2	2·91	36·5	2·576	5·93	14	2·15	14·7	2·134	3·20
3	2·90	37·9	2·591	5·87	15	2·00	10·5	1·910	2·55
4	2·75	30·4	2·506	5·60	16	1·90	13·8	2·091	2·72
5	2·83	36·4	2·575	5·67	17	2·04	15·0	2·143	2·57
6	2·81	32·3	2·531	5·48	18	1·70	16·0	2·182	2·18
7	2·59	25·4	2·426	5·26	19	1·70	14·0	2·100	2·10
8	2·55	34·7	2·560	4·86	20	1·80	12·0	2·000	2·00
9	2·55	36·0	2·571	4·71	21	1·60	15·0	2·143	2·00
10	2·40	26·2	2·441	4·48	22	1·60	17·3	2·228	1·93
11	2·52	28·8	2·483	4·30	23	1·40	10·4	1·902	1·46
12	2·33	36·6	2·577	3·30	24	1·30	15·0	2·143	1·57

It is at once obvious that the observed v are either in error; or that there was a considerable difference in other conditions. Compare for example No. 7 with either No. 8 or No. 9. Compare, again, Nos. 18, 19, and 20, in which d = 3·0 feet.

The above rectangular sections can all be referred to one equation :—

$$f = \frac{3x}{x + 6}$$

Therefore we may write : $v = C\sqrt{m}$, the C being, not a constant, but a variable. Taking an average of C as C_0, we find :—

TABLE D.

No.	Obs. v	C	V_0	Percentage difference.	No.	Obs. v	C	V_0	Percentage difference.
1	2·86	1·17	2·86	......	13	2·25	1·15	2·28	− 1·3
2	2·91	1·15	2·85	+ 2·1	14	2·15	1·20	2·09	+ 2·9
3	2·90	1·20	2·83	+ 2·5	15	2·00	1·25	1·87	+ 7·0
4	2·75	1·16	2·77	− 0·7	16	1·90	1·15	1·93	− 1·6
5	2·83	1·19	2·78	+ 1·8	17	2·04	1·27	1·88	+ 9·0
6	2·81	1·20	2·74	+ 2·6	18	1·70	1·15	1·73	− 1·7
7	2·59	1·13	2·68	− 3·4	19	1·70	1·17	1·70	......
8	2·55	1·16	2·57	− 0·8	20	1·80	1·28	1·65	+ 9·1
9	2·55	1·18	2·54	+ 0·4	21	1·60	1·13	1·65	− 3·0
10	2·40	1·13	2·48	− 3·2	22	1·60	1·15	1·63	− 1·9
11	2·52	1·21	2·42	+ 4·1	23	1·40	1·16	1·42	− 1·4
12	2·33	1·13	2·42	− 3·7	24	1·30	1·04	1·46	− 11·0

C_0 assumed to be = 1·17.

The calculated V_0, by the Kennedy formula $V_0 = 0·84\ d^{·61}$, are compared in like manner with the observed or actual velocities in the same sections :—

TABLE E.

No.	Cal. V_0	Percentage difference.	No.	Cal. V_0	Percentage difference.	No.	Cal. V_0	Percentage difference.
1	2·92	− 2·1	9	2·50	+ 2·0	17	1·91	+ 7·0
2	2·89	+ 0·7	10	2·50	− 4·0	18	1·70	......
3	2·87	+ 1·0	11	2·41	+ 4·6	19	1·70	......
4	2·84	− 3·1	12	2·35	− 0·8	20	1·70	+ 6·0
5	2·81	+ 0·7	13	2·29	− 1·8	21	1·62	− 1·2
6	2·79	+ 0·7	14	2·20	− 2·3	22	1·55	+ 3·2
7	2·79	− 7·2	15	2·04	− 2·0	23	1·43	− 2·1
8	2·56	− 0·4	16	2·01	− 5·5	24	1·39	− 6·5

In table D sixteen observations fall within 3 per cent. of difference; in table E, there are fifteen. The real point to be considered, however, is not so much the fitting of an empiric formula to the observations, as the final and permanent results obtained by the adoption of that formula. Mr. Kennedy, as a practical engineer was convinced that his formula could be satisfactorily used (percolation apart) in the conditions and for the particular sections he observed, and the writer sees no reason for questioning his accuracy of observation, his judgment, or his conclusions. Another vital point is that his formula did not include the width of a section.*

Σ. Φ.

Drafted : *November 1927.*
Revised : *3rd January 1928.*

* This is absolutely the key of the position, and the writer's chief argument against any empiric formula.

BHAKRA DAM PROJECT.

(BY A CORRESPONDENT.)

IN his manner of drawing the attention of Government to the absence of budget provision and his demand for immediate execution of the work at a recent meeting of the Legislative Assembly of the Punjab, Chaudhri Chhotu Ram would appear to know something about the Bhakra Dam project and to have received some encouragement in launching a feeler, for he knows that there are strong reasons, definitely stated by the department immediately concerned, why it cannot be undertaken, for the present at least. He said he wanted the work commenced and without delay. Sir Fazl-i-Hussain replied that he himself and His Excellency the Governor were in sympathy with his demand and that the Government of India were being approached for sanction. Nothing appears to have been said about the rejection of the project a few months ago by the Punjab Irrigation Chief Engineer and Secretary to Government, who said he would not recommend the dam because suitable foundations had not been found at or near Bhakra on the Sutlej.

Have good foundations since been found where there does not appear to be danger of outflanking or undermining and where nothing short of an earthquake need be feared? If so, do we know when the next Dharamsala heave is due to take place? We are not without experience of serious disasters from the bursting of reservoir dams, for example recently in America and Algeria.

The Sutlej Dam, if built, will, it is claimed, be of the "greatest in the world" order, just as were the post-war projects of the Sutlej Valley and the Sukkur Barrage. The depth and volume of water to be held up behind the dam will be enormous. The site is sufficiently near the river debouchment from the low hills to make the valley from Rupar downwards an extremely uncomfortable place to reside in, if and when the supporters of the project have their way.

With all its efficiency the department that has its designs and estimates ready to launch, has not yet established control over the operation of forces responsible for periodical shaking of the Bhakra hills, regardless of consequences.

Ordinarily the Sutlej and Beas in flood demand a lot of attention in the cultivated riverain. What would happen to that part of man and his works that came in the way of a flood multiplied manyfold by the breaching of such a conveniently placed reservoir dam, must be left to the imagination.

On the representation of the Bombay Government in the interests of Sind irrigation, the Government of India have already put a stop to fresh extensions in the Punjab. One of the schemes specifically mentioned to be prevented from materialising before the supplies of sanctioned irrigation projects have been made perfectly secure, is the Bhakra Dam project. The Punjab is itself equally concerned in not placing additional burdens on those tributaries of the Indus that are to provide for coming irrigation that has been sanctioned, for the existing combined supplies of the Sutlej and Beas have been pronounced by the department that is responsible for the success of the Sutlej Valley Project to be insufficient for the purpose. It is difficult to understand how approaching the Government of India to permit the diverting of part of the already inadequate supplies can be reconciled with such an admission. The failure to be insured against should be fully covered before fresh liabilities are proposed.

In trying to understand why it is that such Punjab projects as the Bhakra, Haveli and Thal schemes are repeatedly being brought to the fore, it should be remembered that there is considerable force in the desire to prevent a reduction of the present expanded cadre of the Irrigation Service. When the construction work being carried out at present comes to an end many engineers will come under reduction, unless expansion of construction can be arranged for in advance. After the completion of the Triple Canal Project construction, a reduction of establishment became necessary and was ordered, but was rendered unnecessary by the rushing through of the rough project of the Sutlej Valley. Again reasons for the postponement will have to be found. For this purpose having several completely prepared projects ready to shoot in will be useful. The great difficulty will lie in proving to the satisfaction of Sind that there is enough water for the sanctioned projects of that province as well as for the several fresh proposals held in reserve in the Punjab, because the Bombay Government have already learnt from the inter-provincial water account that more water is absolutely necessary to be arranged for to meet existing and sanctioned Punjab requirements alone, apart from additional deductions for pending projects.

The Government of India will have to be satisfied that steps are being taken to improve the supplies of the Sutlej and Beas sufficiently to cover both Sutlej Valley shortages as well as Bhakra Dam requirements, and that these steps have gone well beyond the stage of theory and have been given practical effect to, before they can be expected to repeat old mistakes and to permit new schemes to be started on nothing more substantial than the assurances of interested enthusiasts that all is well.

A small expansion of the Irrigation Service in the form of a WATER SUPPLY IMPROVEMENTS SECTION would find employment for a certain number of engineers in the hills on each of the rivers supplying our canals and on the linking-up arrangements by which supplies and requirements can be advantageously pooled for the whole province and Sind. We think a start should be made on the Sutlej and Beas at an early date. Advocates of extensions of irrigation should exercise some patience and first strengthen their position in regard to supplies. Meanwhile there is probably not much harm in getting the Central Government to again take the blame for rejecting the Bhakra Dam proposal and others.

THE RESTORATION OF THE ANCIENT IRRIGATION OF BENGAL.

BY SIR WILLIAM WILLCOCKS, K. C. M. G.

A lecture delivered at the British Indian Association Hall, Calcutta, on the 6th March 1928.

THE delta of the Nile is immune from malaria, and I came here from Egypt to see if the delta of the Ganges could not be also made immune. Egypt is a rainless land irrigated by the rich red water of the Nile flood, and as fertile as it is free from malaria. "The garden of the Lord, the land of Egypt," is its name in the first book of the Bible. "Vidi viridem Ægyptum," "I have seen green Egypt" is the remark of the Roman traveller. "Green, inexpressibly green, is the vale known as the land of Egypt" writes the traveller of our day. This is the verdure you will, I hope, see one day in the delta of the Ganges. The

Nile is in flood just when the Ganges is, and its turbid waters are used to irrigate the country by leading them in canals into large basins and then letting them cover the land with their rich deposit. And "as the Nile ebbs the seedsman upon the slime and ooze scatters his grain and shortly comes to harvest."

2. This was the system of "basin irrigation" of the ancient Egyptians, and it is still practised over large areas; but the greater part of the country is to-day irrigated by "perennial irrigation," a system originally introduced by the Babylonians in the Euphrates-Tigris delta. It has been my privilege to study both these systems on the ground, to resuscitate the ancient reservoir of the great Pharaohs of the 12th dynasty of 4,000 years ago, and to project and begin the resuscitation of the ancient reservoir of the old Babylonian kings of more than 4,000 years ago. To-day it is my privilege to show you what was the system of "overflow irrigation" evolved by the wisdom of the great kings of ancient Bengal, and to let you see how you can reintroduce it to-day and bring in again the health and wealth which the delta proper of the Ganges once enjoyed.

3. The delta of the Ganges is no rainless land. It enjoys a rainfall of from 50 to 60 inches just when the Ganges is in flood; and it was to make full use of the rich red water of the Ganges flood and the abundant but poor water of the monsoon rainfall that some great ruler of ancient Bengal thought out and put in practice the system of "overflow irrigation" of the Ganges delta which insured health and wealth to Bengal for thousands of years. This system is as perfectly suited to meet the special needs of Bengal as "flood irrigation" suits those of Egypt or "perennial irrigation" meets those of Babylon. The Bible says with perfect truth that there were "giants in the earth in those days." Menes in Egypt, Merodach in Babylon, and Bhagirath in Bengal were real giants. They thought out and executed works which poured out blessings upon millions and millions of their race.

4. The Mahabharata tells us that as Bhagirath followed by Ganga descended the Ganges, near the head of the delta Bhagirath rested to eat his meal; and Ganga, hearing the sound of Padmati's shell, thought it was Bhagirath's and followed her in her eastern course down the Padma. It was then that Bhagirath sounded his shell and Ganga recognised her mistake. She changed her course and went southwards. Every ancient history in the world, every ancient account in the Bible, is in this parabolic and picturesque language. This is how history was written when the race was in its infancy and nature was full of life. Every canal which went southwards, whether they have become rivers like the Bhagirathi and the Gorai, or remained canals like the Bhairabs, the Jelingis and the Matabhanga, were originally canals lined out and dug parallel to each other. They are spaced apart and placed just where canals should be placed. Ever since I came to Calcutta I have had hung up in my bedroom a big scale map showing all the canals in Central Bengal. Their artificial positions, their continuous alignments, their great widths, their shallow depths, and the villages clustered on mounds on their banks have greatly interested me, but I always thought they were natural rivers. On the 21st of February, however, as Dr. Bentley and I were in the train coming down from Lolaghat on the Ganges, we traversed for some 9 or 10 miles a strip of land covered with rich winter crops, we then crossed a bank and were in the midst of poor scrubby fields of lentils. I said to Dr. Bentley "It looks as if locusts had eaten down these poor fields." He replied that the banks along the Ganges and the Bhagirathi had kept the rich red water of the rivers from flowing over these fields during the monsoon. I then saw in vision Bhagirath leading Ganga in canals across the plains. I saw the spoil banks of the canals left with openings to let the rich red water of the river mingle with and fertilise the rainwater of the monsoon as they flowed together through the rice-fields. I saw the villagers hurrying to the spoil banks and building their houses above the level of the inundation. I saw the canals were broad and deep, carrying the muddy waters of the crest of the river floods and not the heavy silted water of the greater depths. Truly there had been giants on the earth. They lived in spacious days and designed like Titans; and I said to Dr. Bentley—"We too shall be like them. We shall see these things again, and Western and Central Bengal shall again enjoy such health and wealth as God called 'very good' when He created the earth."

5. The extraordinary difference between the luxuriant crops reached by the rich red waters of the floods and the poor scrubby vegetation untouched by them I have seen again and again; but near Burdwan when Mr. Bannerjee, Dr. Bentley and I were on our way to see the head of the Eden Canal, I saw the difference on the side of public health. In the middle of a big deserted village we met a few anæmic peasants, one of whom led us to the regulating headwork. He told us that they were plagued with malaria and had only known one year's real immunity from it and that was the year of the great breach of the Damodar bank upstream of Burdwan when the whole country was flooded. This Damodar bank I shall return to later. Just as "basin irrigation" in the rainless Nile valley cannot be performed without banks, so proper "overflow irrigation" in the Ganges delta is impossible with banks, unless indeed they are everywhere pierced by openings which are more than openings in name. The rich red water of the river and the poor opaque water of the rainfall have to combine as they pass through the rice-fields, and they need diffusion not concentration.

6. Egypt would be partially immune from malaria any way because it uses the rich red water of the Nile flood; but it is absolutely immune everywhere because it also grows everywhere an abundance of leguminous fodder crops which are in flower at the critical time in the lives of malaria mosquitoes. In this way it secures complete immunity from malaria; it secures for the growing crop the fertility of the rich red water of the flood; and it secures for the ground itself the permanency of its fertility by the leguminous fodder crops it grows, with their power to take manure from the air and store it in the ground. These leguminous fodder crops are eaten down by buffaloes and cows; and, as we say in the south of England that the feet of sheep are shod with gold, so the Egyptian has been able to say that the feet of buffaloes are shod with gold. Such is Egypt to-day. It is the richest agricultural country in the world for its size. It cultivates only 5,500,000 acres and lives on its agricultural produce. It pays a revenue of £38,000,000 per year without difficulty and supports a population of 15,000,000 people. Agricultural land can be rented for £20 per acre per annum, with a selling value of £400 per acre. Where is Central Bengal to-day? We know where it was in 1660 when Bernier travelled through it before the incessant fights between Afghans and Mahrattas had disorganized the country. Hear what he says:—

> "The knowledge I have acquired of Bengal in two visits inclines me to believe that it is richer than Egypt. It exports in abundance cottons and silks, rice, sugar and butter. It produces amply for its own consumption of wheat, vegetables, grains, fowls, ducks and geese. It has immense herds of pigs and flocks of sheep and goat. Fish of every kind it has in profusion. *From Rajmahal to the sea is an endless number of canals, cut in bygone ages from the Ganges by immense labour, for navigation and irrigation, while the Indian considers the Ganges water as the best in the world.*"

This picture of agricultural wealth is confirmed by those who followed him.

7. Where is Central Bengal to-day? I am now going to make statements about what I have seen with my

eyes. To forestall anyone contradicting me when I have left Calcutta, I have purposely put off my return to Egypt for a week so that I may go out with anyone who calls in question what I am going to say and examine the ground on the spot. Though I shall have spoken the naked truth, it is the truth which I shall have spoken.

8. The miles upon miles of its great canals have been allowed to silt up and be degraded. This neglect has been called the hand of God, while the canals have been called rivers. Commissions upon commissions have written Jeremiads on them. I give one typical quotation from page 32 of "The Report of the Drainage Committee, Bengal." "In this tract we have a number of dead streams which were once large rivers..... The rivers above alluded to are already dead; to resuscitate them is practically impossible..... It has been urged that the Government has been apathetic..... We do not concur, but consider that money spent would simply have been thrown away..... These rivers can never be reconverted into live streams by the action of man." If Egypt had been so treated it would have been a howling wilderness to-day. The monsoon rainfall has saved Central Bengal from this fate, but its plight is sad enough.

8A. To support their view, the members of the Commission quote a saying of Mr. J. Fergusson about the swing of a pendulum and refer it to what they call "dead rivers." This is a misquotation, for Fergusson refers it to the cutting of the bends of rivers, an altogether different matter. The fact is that Fergusson is quite right, and they are wrong in calling the "uncleaned canals" "dead rivers." They are canals dug by men. Moreover the surface of the ground of a delta like that of the Ganges rises about 4 inches in 100 years simply because the bed and water surface of the river rise 4 inches in 100 years; and the level of the ground to-day bears the same relation to the level of the river as it did in Bhagirath's day. We have no more difficulties than he had. Bhagirath's asset was a stout heart.

9. While Central Bengal enjoyed the rich irrigation of the Ganges floods mingled with the waters of the monsoon rainfalls and reaped fatiguing crop after atiguing crop with no leguminous rotative crops, it drew its cheques on capital and lived its prodigal life. Now however that it has been deprived of its rich red water it has to content itself with rain water for its worn-out fields. Such water cannot restore lost fertility. Forced to grow some kind of legumens it grows the poorest and reaps its scanty harvests. The recorded large areas of legumens are much more reassuring on paper than on the ground. Living principally on rice straw, its cattle are weak and diminutive and scratch the surface of part of the light soil and leave extensive fallows. Over very large areas one single crop in two years is the rule. Kans grass is spreading in the lighter northern districts and will travel apace. The fall of the subsoil water, severest in the north and less and less severe as one goes south, is telling on the fertility of the countless mango and other fruit trees, which are shallow rooted as they were once accustomed to other conditions. The absence of pools has deprived most of the peasantry of the fish they once had in abundance. Drinking water is often scarce. The food of the peasantry is as little nourishing as food can be, and they are, on the top of it, scourged with malaria, which nothing but the rich red water of the Ganges flood or leguminous fodders can combat; and these are the two things they never see. The day is not far off when Government will have to provide light steam ploughs to the northern districts to enable the peasantry to grow food to live at all. I am prepared to confirm what I say on the ground and I add that it is a real calamity that nearly all the mail trains coming out of or going into Calcutta through Central Bengal go by night.

(To be continued.)

The Gazettes.

Burma, February 18, 1928.

Buildings and Roads Branch.

On return from leave, Mr. A. S. Carr, Temporary Engineer, is reposted to the Pegu Circle.

The following Temporary Engineers, recruited in England by the High Commissioner for India, reported their arrival at Rangoon on the 8th February 1928 and are posted to the Mandalay Circle for training in the Division noted against each:— Mr. Walter Langholm Connell, Toungoo; Mr. James McDougall Gordon, Pyinmana; Mr. James McPherson Todd, Mandalay.

Leave on average pay for eight months is granted to Mr. R. S. Andrews, M. C., I. S. E., Assistant Executive Engineer and officiating Executive Engineer, Taungdwingyi Division, with effect from 1st April 1928, or such subsequent date as he may avail himself of it.

Mr. L. Mun Tut, Assistant Sanitary Engineer, is confirmed in his appointment.

Mr. A. G. Longley, Assistant River Conservator, has been granted, by the High Commissioner for India, leave on half average pay for six months on medical certificate, in extension of the leave granted him previously.

Bihar and Orissa, March 7, 1928.

Public Works Department.

Mr. H. A. Gubbay, Chief Engineer and Secretary to the Government of Bihar and Orissa, Public Works Department, Buildings and Roads Branch, is granted leave on average pay for six months and twenty days, with effect from 10th April 1928.

Mr. J. G. Powell, Superintending Engineer, North Bihar Circle, is appointed to officiate as Chief Engineer and Secretary to the Government of Bihar and Orissa, Public Works Department, Buildings and Roads Branch, *vice* Mr. H. A. Gubbay, granted leave, or until further orders.

Rai Bahadur Kshirod Chandra Sen, Executive Engineer, University Division, is appointed to officiate as Superintending Engineer, North Bihar Circle, *vice* Mr. J. G. Powell, appointed as officiating Chief Engineer and Secretary to the Government of Bihar and Orissa, Public Works Department, Buildings and Roads Branch, or until further orders.

Mr. W. A. Garson, Executive Engineer, is transferred from the Chota Nagpur Circle to the South Bihar Circle, and is posted to the charge of the University Division.

Mr. F. A. Betterton, Superintending Engineer, Chota Nagpur Circle, is granted leave on average pay for six months, with effect from 2nd May 1928, or from any subsequent date on which he avails himself of it

Mr. S. K. Ray, Executive Engineer, Cuttack Division, is appointed to officiate as Superintending Engineer, Chota Nagpur Circle, *vice* Mr. F. A. Betterton, granted leave or until further orders.

Punjab, March 9, 1928.

Buildings and Roads Branch.

Mr. J. A. Barber, a Superintendent in the Punjab Public Works Department Secretariat, Buildings and Roads Branch, is appointed to officiate as Assistant Secretary to Government, Punjab, Public Works Department, Buildings and Roads Branch, during the absence on leave of Mr. G. E. J. Haegert, and took over charge of his duties from the latter from 23rd February 1928.

Mr. L. S. Adlard, Executive Engineer, took over charge, as a temporary measure, of the 2nd Circle of Superintendence in addition to his own duties as Executive Engineer, Ambala Provincial Division, on 18th February 1928, from Mr. D. Macfarlane, Officiating Superintending Engineer, transferred.

Mr. D. Macfarlane, Officiating Superintending Engineer, whose services have been placed at the disposal of the Government of India, relinquished charge of the Second Circle of Superintendence on 18th February 1928, and reported his departure for Delhi the same date.

Irrigation Branch.

The undermentioned qualified Engineer Students of the Thomason Civil Engineering College, Roorkee, have been appointed to the Punjab Service of Engineers, as Assistant Engineers on probation, with effect from the dates noted against each:—

Lala Amar Nath, Malhotra, Derajat Circle, 1st November 1927; Lala Khushi Ram, Sharma, 3rd Bahawalpur Circle, Sutlej Valley Project, 1st November 1927; Lala Bir Sen, Talwani, Upper Chenab Canal Circle, 1st November 1927.

Sheikh Masud Ahmad Rashid, Assistant Engineer, on transfer from the Delhi Division, Western Jumna Canal, which he left on 10th February 1928, joined the Punjab Irrigation Secretariat, on the 21st idem.

Mir Habib Ullah has been appointed a Temporary Engineer and posted to the Gujrat Division, Upper Jhelum Canal, with effect from 30th January 1928.

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INDIAN ENGINEERING.

SATURDAY, MARCH 24, 1928.

MR. C. E. STOTHERD, M. INST. C. E.

II.

THE railway work of the Jaipur State, though of course not unimportant, has alway been accessory to the more normal public works of the State which are in progress at all times. Of such works prominence may be given to those for irrigation, in which aspect Jaipur stands first of all the States in Rajputana. Sir Swinton Jacob, early in his time, had noticed how the name of Colonel Dixon was remembered in Ajmere and Merwara with affection for the tank works he constructed, and Jaipur offered similar opportunities. There are no perennial streams in the State, and action lay in the construction of storage reservoirs to impound as much of the monsoon rainfall as was possible. There were 130 dams and reservoirs when Mr. Stotherd entered the service of the State in 1896, there are now about 231, of which some few are of considerable magnitude. They are of various types to suit the local conditions, and range from works designed to irrigate only a few bigahs of land to dams whose lengths are measured in miles and reservoirs with areas of 6 to 7 square miles, with depths up to 75 feet, capable of irrigating 40,000 bigahs. The different types were described by Mr. Stotherd in an interesting paper on the subject, contributed to the Institution of Civil Engineers. The Jaipur Darbar has for many years adopted a liberal attitude towards the construction of such works, and the capital sum expended on them is said to amount to approximately 1½ millions sterling. Of the great value of the works to the State and the people there can be no question, the revenue realised to date has been estimated at over a million sterling, the works are an insurance against deficient rainfall and consequent drought, they tend to maintain the spring levels in surrounding wells, they enable the empty beds of the reservoirs to be cultivated in addition to the flow irrigation, and they provide drinking water for men and animals and employment for the population especially in times of famine.

In the matter of roads, Jaipur has now 308 miles of metalled roads and 226 miles of unmetalled and graded roads, the latter at river crossings are provided with metalled approaches and paved causeways. A good many miles of unmetalled roads have been laid with kunkur in Mr. Stotherd's time; but the most important new work, certainly the most interesting, is the new metalled road over the hill ghat pass between Jaipur city and the old capital of Amber, a thoroughfare formerly impassable to wheeled traffic. The new road is graded at 1 in 20 to 1 in 25, and the crest of the hill has been cut down through solid rock to a depth of 50 feet. Where the ancient fortifications are penetrated, a fine battlemented gateway passable by elephants, with protecting bastions and furnished with

guard-houses, has been built at the point at which the new road surmounts the crest and enters the long and deep rock-cutting. The cost of this road was about one lakh of rupees, of which one half was spent on the rock-cutting at the crest. The buildings constructed since 1896 include the Rambagh Palace Guest House, a new Operation Room at the Mayo Hospital, the Curzon Wyllie five Residential Wards opened by Lady Hardinge in 1912, the Lady Hardinge nine Zenana Residential Wards opened by Lord Reading in 1922, the King Edward VII Memorial outside the Ajmere Gate of the city opened by Lord Hardinge in 1912, the accommodation for a complete broad-gauge and metre-gauge train with residential annexe to provide for the private trains of His Highness the Maharajah, and similar accommodation for His Highness' private metre-gauge train at the Hathroi Kothi. In addition many public buildings, such as a new jail for female prisoners, tahsils, thanahs, rest-houses, dispensaries and other buildings of general and administrative utility have been constructed all over the State.

The city water supply merits more than a passing mention. In 1906, the sand dam, 61 feet in height and 800 feet in length, which had been completed in 1885 to supply the city with water, had silted up to a considerable extent; and there had also been a long series of years of deficient rainfall. The water-works had in fact failed so often to meet the needs of a city with 140,000 inhabitants that something had to be done, and Mr. Stotherd decided to sink a series of deep wells in the bed of the reservoir and to connect them by a long subterranean suction main to the pumps, with down pipes into each. The 15 wells first sunk are 80 feet apart, 20 feet in internal diameter, and they were sunk to depths 40 to 50 feet below the original bed of the stream. To render them safe from overtopping when the reservoir filled, the shafts were raised to a height of 110 feet, and the whole were banked in for security in times of floods and revetted with rubble stone. The first 10 wells are connected by a culvert, 5 feet 9 inches internal diameter, 25 feet below the bed of the reservoir. In this is laid the 18 inches suction main reducing to 15 inches, 1,800 feet in length, from which the pumping engines can draw simultaneously on the whole series of wells down to 25 feet below the pumps and original bed level of the reservoir. It is believed that such a long length of suction main of this size and drawing to maximum depths of suction is unprecedented. Any air finding its way into the main, which is laid at a fall of ½ inch per 100 feet, rises to an air vessel and is drawn out by a small air pump continuously in action on the principle of the vacuum brake of a train. In 1915, the 15 wells were supplemented by 5 more wells, 15 feet internal diameter, sunk outside and below the original main dam and weir, and drawn upon by an auxiliary pump when necessary. By means of these 20 wells, and 2 old wells, a clean and filtered supply of water is obtained up to an average of one million gallons a day. A pair of twin marine type vertical pumping engines, supplied by Messrs. Hawthorn Davy and Co., of Leeds, each capable of pumping one million gallons of water a day to a height of 110 feet into the service reservoir, were installed in 1913 to supersede the former engines which were unsuitable for drawing water under suction. A paper descriptive of the above work was contributed by Mr. Stotherd to the Institution of Civil Engineers.

Before leaving Jaipur, Mr. Stotherd, assisted by Mr. J. E. Baker, the Darbar's engineer in charge of the pumping station, drew up an entirely new scheme for pumping water from the Bandi river over a ridge 12 miles north of the city; and it was claimed for this scheme that it had the advantage of providing an unlimited supply of water at a level higher than that of the city, and adjacent to the Jaipur State Railway crossing of the Bandi river, where coal and accessories can easily be delivered and the installations readily supervised. The scheme has the further advantage that the cost of maintenance and recurring charges would be much less. But in addition to the works mentioned above, Mr. Stotherd had many other duties. He had the superintendence of the cotton presses and the gas works, and in 1912 a factory of 40 gins, capable of being doubled at any time, was designed and constructed by Mr. Stotherd. The famine relief works in the years 1899, 1901, 1913 and 1915 were also in his charge, as were the arrangements for the Jaipur State camps at Delhi in connexion with the Coronation and King's Darbars. The Public Gardens, with its Zoological Section, are also under the superintendence of the Jaipur P. W. D. These extensive gardens are well known throughout India, and in them is the beautiful Albert Hall, with its marble domes, canopies and balustrades, designed and constructed by the late Colonel Sir Swinton Jacob. The foundation stone of the Hall was laid by H. M. King Edward VII, then Prince of Wales, on 6th February 1876, and the building was finally completed in 1887 at a cost of 5 lakhs of rupees.

When Mr. Stotherd retired in 1923, after 27 years of service in the Jaipur State, he left a great tale of work behind him. In succeeding Sir Swinton Jacob he had a difficult man to follow. Not, indeed, that he was less accomplished as an engineer, he had doubtless the higher technical qualifications; but Sir Swinton had his exceptionally long experience of the State and a personal charm of character which tended to make the path easier and smoother for him than it might have been for most men. His forty-five years in Jaipur were very notable years, and notable too was the good and uninterrupted progress of public works in the State during the time of Mr. Stotherd's tenure of office. Amiable and "all things to all men" as Sir Swinton was by natural temperament, he was nevertheless a good judge of men, and he showed it when he recommended the appointment of Mr. Stotherd as his successor. Subsequent events proved that choice to be justified. It was fortunate that just at the time when railway construction was about to be commenced in the State, Mr. Stotherd's previous experience should have lain in that branch of work, but it was not merely

that he happened to have had that experience, he was an excellent, all-round, practical engineer of good judgment and common-sense, and it was once said that, although he was medically rejected for the Public Works Department of India by reason of his short-sight, the Government in rejecting him was the shorter-sighted of the two. He would have done good work in the Public Works Department wherever he had been placed, but Jaipur gained by that accident an engineer who showed by his conduct of the engineering affairs of the State how valuable he was. Mr. Stotherd was elected an Associate Member of the Institution of Civil Engineers in 1896 and a full Member in 1922. It is understood that he has been succeeded at Jaipur by Mr. S. H. Bigsby. Of the staff who served with him, Mr. Stotherd always spoke highly of the late Rai Bahadur Lala Rup Chand, Sahib Lala Indra Sahai, B. A., B. Sc., Babu Ram Ditta Mal, B. A., all of the Roorkhee College, and the late B. K. N. Mukerji of the Sibpur Engineering College.

KIDDERPORE DOCKS.

IN the "Lectures on Harbour and Dock Engineering at the Port of Calcutta" by Mr. J. McGlashan, M. Inst. C. E., M. I. E. (India), the author said that it might often have been wondered why the existing docks of Calcutta were located at Kidderpore so far up the river from the open sea, and he related the history of the reasons which led to the adoption of this site. In 1881 the Government of India sanctioned the construction of a branch line of railway from Calcutta to Diamond Harbour, and it was then that the question of constructing wet docks at Diamond Harbour in connexion with that railway came under consideration. The idea of the docks at Diamond Harbour arose from the desire to avoid the risks and delays to which ships were liable in navigating the Hooghly above that location, and to prevent vessels having to lie in the open tideway of the river where they were subjected to the dangers of storms and cyclones.

But that was not the first time that docks had been proposed, as far back as 1824 there had been a proposal to construct docks somewhere in the neighbourhood of Calcutta, and in 1831 a survey was instituted to ascertain the possibilities of a ship canal from Calcutta to the head of the Mutla river. The navigable canal idea introduced another feature into the controversy, and discussions continued till 1842 when a hurricane in the Hooghly did so much damage that wet docks in the vicinity of Kidderpore were suggested at a cost of Rs. 50 lakhs. Nothing was done at the time although for some years the Chamber of Commerce pressed for dock accommodation to satisfy the requirements of commerce in Bengal. In 1866 an attempt was made to meet the increasing trade of Calcutta by the creation of Port Canning in connexion with the Calcutta South-Eastern Railway. The scheme was commenced, but owing to various objections was ultimately abandoned. Then the ship canal alternative came to the front again and received more detailed enquiry without any decision being reached. In the meanwhile trade continued to expand, in 1861 the net tonnage of steamers and sailing vessels was 66,800, and in 1876 the corresponding figure was 1,000,593. This increase had, moreover, taken place while the railway system of Bengal was far from complete, and railway extensions in contemplation would, as was known, lead to further increase of trade. Timber ships were also giving way to iron ships of greater carrying capacity, the question was becoming very urgent, and the Diamond Harbour project gained ground as the most practical scheme that had up to that time been proposed. For all classes of goods to be transported direct to docks at Diamond Harbour without the necessity of detention and examination in Calcutta there would be, it was contended, an immense gain.

The Diamond Harbour scheme, if carried out, would certainly diminish the expensiveness of difficult river navigation in 120 miles, involving heavy charges in pilotage and detention, but on the other hand there was the inconvenience entailed by the separation of the shipping from the mercantile offices in Calcutta, and the Lieutenant-Governor referred the matter back to the Port Commissioners for further investigation. The Committee then appointed held that docks at Diamond Harbour would not be economical for the shipping nor convenient for the trade of the port, and they recommended the construction of wet docks at Kidderpore connected with the town jetties by a railway along the river bank. The Howrah Floating Bridge, constructed about that time, precluded the selection of any site above that bridge, and Kidderpore being the nearest locality south of the site, the Government arrived at the opinion that Kidderpore was the best possible site on the Calcutta side of the river. The Kidderpore Docks were accordingly constructed.

CANE-CRUSHERS IN THE DECCAN.

RAO BAHADUR P. C. PATIL, L. Ag., M. Sc., Acting Principal of the Agricultural College, Poona, is the author of an interesting bulletin, issued by the Bombay Department of Agriculture, on "Sugar-cane Mills and Small Power Crushers in the Bombay Presidency." The subject is interesting because the conditions of sugar manufacture have changed considerably in the last two decades or so and are still changing. The cane industry of India dates of course from very long ago, but in the Deccan until lately the cultivation of cane appears to have been a dilletante sort of business, a crop for a successful farmer of some substance, who took a pride in putting at least a small area of land under sugar-cane, and who used the produce for his own consumption and distribution to his relatives and friends. The crushing of the cane and the making of the *gul* (the Deccan word for what is known as *gur* in Upper India) were made an occasion for festivity, and the cane-grower invited his relations and friends to a juice party. Labour was paid in the shape of cane, juice or *gul*, and the village people partook of the cane

and juice without restriction. It is a delightful picture of a rural scene in an older India. The author says that when he joined the Agricultural Department in 1906, except on the canals, the mills used were the old wooden mills, and the music of these mills could be heard at night between November and February over many parts of the Deccan. The old wooden mills were a device for extracting the juice from cane and as old in origin as the cultivation of cane. The mill was a sort of pestle and mortar affair, and if it had not a high efficiency, the cultivation of cane was on a small scale. The crop has, however, a relatively high money value in comparison to its area. The area in the British Bombay Deccan and Karnatak is given at about 60,000 acres, but the value of *gul* from it would be Rs. 2½ crores a year at moderate prices.

The position in the Deccan changed as protective irrigation works were constructed in fairly rapid succession. The canals gave a great stimulus to cane cultivation, sugar came to be more and more of a business proposition, instead of a question of finding employment throughout the year by means of lift-irrigation from wells, and the industry was placed on a commercial basis. The mills were improved, and with the improvement of the mills there came the question of the furnace. The operations of milling the cane and boiling the juice into *gul* are inter-dependent. If the mill turns out more juice than can be dealt with by the furnace, the mill has to stand idle till the pan is ready to receive more juice; and if the mill cannot keep pace with the furnace, the crushing is apt to be done imperfectly. It is therefore essential that the mill, the furnace and the labour gang should be of economic power in their inter-relationship. In short, the economics of the matter came increasingly into play as the farmer, instead of growing a little cane for family uses, aimed at supplying raw sugar to the Indian market. The wooden mill had a low efficiency, suitable *babul* wood for making the mills became less abundant, and there was a distinct need for a more durable and more efficient crusher. The bullock-power, three-roller iron-mills for small holdings and the power-crushers for large holdings were thus brought into use, and the time-worn wooden mill practically disappeared.

The bulletin divides the bullock-driven iron-mills used in the Bombay Presidency into two types, the Bari (named after its originator, Mr. Ramaji Raghunath Bari) in which rollers are arranged in a line, and the Chattanooga (American) in which the rollers are arranged in a triangle. The Bari mill crushes 650 to 700 lb. of cane per hour, extracting 64 per cent. of juice, and requires a draught (obtained from four bullocks) of 3½ cwts. The price of this mill is Rs. 190. The Chattanooga Company of America has introduced into India a number of mills of similar design, but of different sizes. Of these the Chattanooga No. 23 is said to have been found the most suitable under Deccan conditions. The mill crushes about 700 lb. of cane per hour, extracting 64 to 66 per cent. of juice, and requires a draught of 3 to 3½ cwts. The price of this mill is Rs. 272. The bullock-driven mill satisfies the requirements of the smaller cultivators, but the farmers who grow sugar-cane on a large scale find the power crusher of great value to them. It gives a higher extraction of from 5 to 8 per cent., and the gain in extraction with the saving of labour is valued at Rs. 100 an acre for an average crop. The credit of the introduction of power crushers lies with the Agricultural Department, and of the several makes on the market, the Chattanooga power crushers are stated to be the most suitable for present conditions both in capacity and price. The bulletin gives a very good description of the various types of mills which have been tried.

BRIDGES.

THERE is a capital article on the subject of Bridges by Sir E. Owen Williams, K. B. E., in "The Architects' Journal" of 22nd February. The story of the bridge, the author says, is the story of our present civilisation. In olden days when construction took the form of a beam or lintel of stone or timber, the limits of the bridge were severely restricted. The Romans developed the principle of the arch in bridges, but it was not till the great engineers of England, such as Smeaton, Rennie and Telford, made bridge-building an art that any great progress came. Still at first, the material was mainly stone. Rennie may be said to be of the last of the stone-bridge builders and Telford of the first who built in metal embodying principles other than those of the arch. Rennie built the Waterloo Bridge, the last of the great stone bridges, and Telford built the Menai Suspension Bridge, the first bridge of modern metal type. The introduction of mechanical transport then gave a great impulse, the steel that made mechanical transport possible made possible also the vaster bridges that mechanical transport demanded. Railway bridges of great span were constructed, of which an outstanding example is the Forth Bridge. The total length of the Forth Bridge is 1½ miles, and apart from the smaller spans in the approaches there are the two great spans of 1,750 feet. The weight of one of the great spans is about 16,000 tons, and the Menai Bridge, a wonder as it was when it was constructed, is a baby to it. The bridges of a former day seldom had to carry more than a wagon weighing a ton or so, and railway bridges have now to carry trains of great weight. But the heaviest train crossing the Forth Bridge is a very small addition to the weight of the structure, and the bridge suffers greater strains from heavy gales than by the passage of trains. In addition to the great fixed bridges there are the movable bridges, and the earliest form of the movable bridge was perhaps the pontoon. But now we have the Tower Bridge, the largest bascule bridge in the world, the great feature of which is the middle span of 200 feet with its two great leaves, each weighing over 1,000 tons. To say nothing of the Romans we have progressed very far since the days of Telford and Brunel.

Notes and Comments.

Concrete Telephone Kiosks.—During the past four years over 4,000 concrete telephone kiosks for public use have been erected in various parts of Great Britain and the installation of these structures is being maintained at the rate of over 20 each week.

Egyptian Railway Organisation.—One of the principal officers of the Government of India is shortly to visit Egypt to study the working and the organisation of the railway departments and especially the conditions relating to the railway budget. Every facility will be provided the visitor in connection with the task.

Students' Excursion Train.—Besides the excursion train for students which has been announced to leave Howrah on a tour on 2nd April, the East Indian Railway propose to run two similar trains, one for the students of the Universities of Lucknow and Allahabad, and the other for those of the Universities of Delhi and Aligarh. Arrangements will also be made for tours to Roorkee and Calcutta.

Persian Railways.—The Committee appointed to examine tenders for the new Persian Railway line from the Caspian to the Persian Gulf has found the American and German prices most favourable. It seems probable that the section from Bandar Igaz (or Gaz) on the Caspian to Teheran will be given to a German company and the section from Teheran to Bandar Khormusi on the Persian Gulf to an American company.

Messrs. Sajan and Co.—This long standing firm are well known throughout India for the excellence of their products—tiles, marble and metallic ceilings. They are extending their business and are supplying glass, hardware, sanitary ware, wood, paint, etc. In addition to these materials the firm's miscellaneous department are prepared to supply anything that their customers may require. The firm's address is 18, Custom House Road, Fort, Bombay. The firm have always given satisfaction to their clients.

The Eastern Bengal Railway.—With a view to providing a more frequent train service and to placing the company in a position to compete with the omnibus service in the suburbs of Calcutta, the management of this railway have been carrying on an experiment in passenger traffic with a "Sentinel" tractor engine on the broad gauge section of the main line between Sealdah and Barrackpore. Each of the trains which are being run between Sealdah and Barrackpore daily consists of two ordinary bogey carriages only. This type of train is known as the "Omnibus Train."

Cables and Wireless.—The proposals regarding the fusion of interests of the Eastern Telegraph and Associated Companies and Marconi's Wireless Telegraph Company contemplate the formation of a holding company with a capital of £53,700,000, of which the companies will hold varying proportions, but an aggregate of £36,350,000 will be allocated to the Eastern Telegraph and Associated Companies and £17,350,000 to Marconi's. The Eastern Telegraph Company will have 56·25 per cent. voting strength and Marconi's 43·75 per cent. The new company will acquire (1) the whole of Marconi's capital, which will be satisfied from the foregoing consideration; (2) the whole of the Eastern Telegraph's ordinary shares, leaving preference shares and debentures undisturbed. The board of the new company will consist of twelve nominees of the Eastern Telegraph and eight of Marconi's.

New Steamer Company.—The Orient Steamship Company, owned by Framjee and Company, Bombay, sent their steamer "Helikon" to the Coromandel Coast for the first time for passenger service. The new company is represented by Soraine and Company who commands respect among Burma-going passengers, especially Oriyas. Passengers whose comforts were hitherto neglected, are now conveyed by motors and given better accommodation. The B. I. S. N. Company are reducing passage rates from Rs. 14-1-9 to Rs. 10 while the new company are booking at Rs. 14-2. Both companies carried about 200 passengers each to Rangoon.

Bombay Housing Scheme.—Mr. Nariman, in the Bombay Legislative Council, moved the omission of the total establishment charges under the Industrial Housing Scheme. The amount invested being Rs. 4½ crores and the return about Rs. 3½ lakhs annual rental, it amounted to less than 1 per cent. He suggested that the only way to put an end to further losses under the scheme, including Rs. 14 lakhs from the cotton cess, was to transfer all the chawls to the Municipality, P. W. D., or Railway, or to find other ways to dispose of them. The representative of the Millowners' Association urged that in view of the curtailment of the original housing programme, the cotton cess, which was imposed in order to help it, should be proportionately decreased. It might be possible to induce workers to occupy the vacant chawls if the Municipality insisted on the improvement of the sanitary and other conditions of their present housing. Further consideration was adjourned.

Lillooah Workshops Situation.—Two officers have been appointed by the Railway Board to examine the programme for reductions at Lillooah, prepared by the Agent, East Indian Railway. They are to report to the Government of India on the number of men required in future for the efficient and economical working of the shops, and, if a substantial reduction in numbers is found necessary, on the manner in which it should be carried out, and the steps to be taken to prevent avoidable hardships to the men affected. The enquiry will commence at once. The Government of India make it clear that the officers are not concerned with, and are not authorised to enquire into the origin or merits of the dispute which has led to the present situation at Lillooah. About 400 men of the Howrah Stores and 500 men of the Block Signal Departments, East Indian Railway, suspended work on Tuesday last. The men remained at their respective posts but, like the Lillooah workmen, they did no work.

B. and N.-W. Railway Advisory Committee.—At the last meeting of the Local Advisory Committee of the Bengal and North-Western Railway, held at Muzaffarpur, it was agreed to provide an Indian Refreshment room at Darbhanga, and to run through inter and 3rd class coaches between Semaria Ghat and Darbhanga by Nos. 9 Up and 10 Down and connected trains. It is also proposed to run a composite 1st and 2nd class carriage between Paleza Ghat and Gorakhpur by Nos. 16 Down and 103 Up and 56 Down and 7 Up trains. It was also agreed to the introduction of 1st and 2nd class mileage coupon tickets as a facility for representatives of mercantile firms. In reply to a question as to whether a suitable site had been found for the new bridge across the Gundak to replace the old Bagala bridge, the Agent explained that this had been found near Dumaria, and that the present proposal was to run a branch line to Parsauni taking off the projected line from Chakia to the new bridge.

Aerial Survey Work.—According to a British official wireless message aeroplanes are being increasingly employed for aerial survey work and a British firm, Aircraft Operating Company, which has specialised in this direction has designed a special craft for this purpose based on experience during surveys in Northern Rhodesia. The pilot sits in the nose of the machine and the photographer operates his camera from a special cabin under the pilot with a vertical view of the ground through windows in the floor. The machine has special engines to permit of continuous flights at great heights over unmapped bush. The operating company is at present completing a survey of the Zambesi River for the Northern Rhodesian Government and is preparing maps of an area of 6,000 miles. An expedition has now been despatched to Baghdad to carry out a survey of 1,000 square miles in the vicinity of the city on a scale of six inches to the mile. One of its representatives is now in South America arranging for an aerial survey of certain cities and harbours.

Staff Changes, B.-N. R.—Subject to the Board's confirmation, the following acting appointments are sanctioned with effect from 1st March 1928:—Mr. A. B. George, 3rd Personal Assistant to be Acting 2nd Personal Assistant and Joint Secretary to the Agent, *vice* Mr. W. B. Purkis transferred. Mr. D. C. Chowdhury, 4th Personal Assistant to be Acting 3rd Personal Assistant, *vice* Mr. A. B. George promoted. Mr. A. W. Beckett, Temporary Personal Assistant to be Acting 4th Personal Assistant to the Agent, *vice* Mr. D. C. Chowdhury posted as Acting 3rd Personal Assistant.—Mr. J. M. Watson, Assistant Loco. Superintendent, on his reporting for duty to the Chief Mechanical Engineer on 5th March 1928, has been posted to Adra as Acting District Loco. and Carriage Superintendent, *vice* Mr. J. C. G. Baillie who is under orders of transfer to the office of the Superintendent, Carriage and Wagon Branch, Khargpur. Mr. J. P. McNamara, Assistant Commercial Officer, Shalimar, is transferred to Khargpur on special duty. Mr. Sukumar Sen, Assistant Commercial Officer, Khargpur, is transferred to Shalimar, *vice* Mr. J. P. McNamara.

Dam Burst Disaster.—The latest report of disaster from the bursting of a reservoir dam comes from Los Angeles, California. The cable says the pretty valley of San Francis Quito Canyon has been transformed into a wreckage-strewn desert of thick yellow mud in which thousands of volunteer workers belonging to every rescue organisation in California is searching for bodies. From Newhall (California) a message says that 200 bodies have been recovered and that a further 800 are said to be missing. A reservoir dam, 100 feet high, in the canyon, 40 miles from Newall, is said to have been wrecked by an earthquake, releasing a flood which surrounded several townships. The dam was part of the water supply of the city. Over 150 workmen perished in a construction camp and it is feared 30 Indians have been drowned in a ranch. As the earthquake was not felt elsewhere it is doubtful whether the collapse of the dam was due to earth tremor or to defective foundations. In view of the proposals to construct dams for reservoirs in the Punjab hills, at Bhakra on the Sutlej, Uhl on the Beas and elsewhere, for holding up flood water for irrigation and hydro-electrical works, it may be advisable to have the recent failures of masonry dams enquired into and reported on.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 8th March 1928:—Messrs. Parry's Engineering, Ltd., Calcutta—15 Trucks, concrete, 2 feet 6-inch gauge, with two tubs each ¼ cubic yard capacity, fitted with brake, Rs. 3,675 free delivery at Pathankot railway station by 31st May 1928; 35 Trucks, concrete, 2 feet 6-inch gauge, with two tubs each ¼ cubic yard capacity, without brake, Rs. 7,595 free delivery at Pathankot railway station by 31st May 1928; Messrs. Braithwaite and Co., Engineers, Ltd., Calcutta—2 Tanks, pressed steel, 8 feet by 8 feet by 4 inches, complete with covers, Rs. 1,674 free delivery at Bannu railway station by 14th March 1928; Messrs. Jessop and Co., Ltd., Calcutta—2 Scarifiers, 4 tyne, independent, complete with draught iron for attaching to front of road roller, Rs. 3,428 free delivery at Bannu railway station by 18th May 1928; Messrs. Turner, Hoare and Co., Ltd., Bombay—2 Excavators, dragline, "Priestman," with 20 b. h.-p. engine, complete with spares, Rs. 39,850 free delivery at Sangle Hill railway station by 25th August 1928; Messrs. Martin and Co., Calcutta—424 cwts. Rounds, M. S., ½-inch, Tata, Rs. 3,392 f. o. r. Howrah; Messrs. William Jacks and Co.,—46 running feet Culverts, Armco, 60-inch diameter, 12 G., Rs. 1,783 free delivery Sukkur Bunder.

The Air-Boat, the "Calcutta."—"Modern Transport" gives a description of an all-metal flying-boat, the "Calcutta," built by Short Bros., Limited, and destined for use in India and Burma. The boat was launched at Rochester and made her first flying test on 21st February. After further tests, it is said that she will be employed on the Southampton-Guernsey service before being sent out to India. The "Calcutta" is the first all-metal commercial air-boat built in England, and she has been constructed with a view to providing modern commercial requirements with maximum safety. There are three engines, on any two of which she can fly, thus practically preventing any necessity of a forced landing. The engines are Bristol "Jupiter" engines, each developing 485 h.-p. at 2,000 r. p. m. The petrol is carried in two tanks in the upper plane, and the engines are fed by gravity. The pilots are accommodated side-by-side in a roomy cockpit in the bow, whence a view can be obtained in all directions. The main passengers' cabin is 17 feet long, 6 feet 6 inches wide and 6 feet 3 inches high. The seats are upholstered and fitted with collapsible tables for the passengers' use. The sides of the cabin are provided with large plate-glass windows, so that the passengers have a good view. As there is no petrol carried in the vicinity of the hull, smoking will be permitted. There is a lavatory compartment, and a buffet, in charge of a steward, with cookers and an ice-chest for hot and cold refreshments. In all respects the boat would appear to have been constructed to meet the requirements of comfort for the passengers, and her arrival in India will be awaited with interest.

Mr. Harvey to get Rs. 60,000.—The General Member of the Bombay Council moved a supplementary demand for Rs. 60,000 for payment to Mr. Harvey, as Mr. Nariman had failed to prove the charge of deliberately altering the indent for mild steel bars for a corrupt and dishonest motive. Mr. Nariman argued that, as the amount represented expenditure already incurred, it should not be the subject of supplementary

demand. The Finance Secretary replied that the contingency arose after the decision in the case on the 27th January 1928 and that the judgment settled the issue for the purpose of the Finance Department. The President accepted this argument and ruled the demand to be in order. The General Member said the Magistrate held that Mr. Nariman had failed to prove corrupt motives in altering the indent and therefore Mr. Harvey should be reimbursed according to the Government resolution. The non-official benches said that Mr. Harvey had not been exonerated and did not deserve the costs of the case. Mr. Nariman contended that the case against him was intended to persecute a political opponent. In support he quoted from a Government letter inviting him to supply them with facts regarding corruption in the department and saying he had only to supply information and the responsibility of proving or disproving the allegations devolved on an impartial tribunal, which would be appointed. He accepted the invitation and laid his facts before the Mears Committee. Then Government went back on their word and ordered his prosecution. He had only placed the facts before the Committee, but not his own inferences from those facts. Those facts the Magistrate held to have been proved.

Railway Publicity.—The Secretary of State has accorded sanction to the proposal for the extension of the Indian State Railways' London Publicity activities, which involve the establishment of an independent Indian State Railways' publicity bureau in London and the appointment of a manager and assistant manager in charge thereof. Mr. A. T. Stowell has been designated manager and Mr. V. H. Boalth, assistant manager. It is hoped that they will take up their appointments at the end of May. Mr. Stowell leaves India for England during this month. The film production officer visited Calcutta recently, and in consultation with officers of the East Indian and Eastern Bengal Railways and the local Government, a tentative programme has been drawn up covering a wide range of films. Negotiations are in progress with the Government of the United Provinces for the running of a demonstration train in that province next cold weather. The Eastern Bengal Railway demonstration train left Calcutta on 21st February and is making a successful tour in Bengal. A system for checking the actual attendance of visitors to the train has been introduced. It has been found that at Diamond Harbour on one day 4,000 people passed through the carriage and 10,000 people attended the lecture and cinema exhibition in the evening. In connection with the E. B. R. train arrangements have been made to provide a travelling *shamiana*, which will be pitched in the neighbourhood of the train at each halting station and in which representatives of all departments are posted, their propaganda literature displayed and general inquiries be answered. The North Western Railway demonstration train has continued its successful tour and the audiences at Delhi, which it recently visited, amounted to 10,000 people each night.

Non-Corrodible Steels.—Many men whose opinion is worth considering are of the opinion that long before the twenty-first century has commenced, all steel exposed to the action of the air will be of the non-corrodible or stainless variety. At the present time the price of such steels is on the high side, but the demand is now increasing so rapidly as to lead to economies which will ultimately reduce the selling price of the material, but it must be kept in mind that the metals to form the alloys used are costly, and it is evident that it will never be possible to buy non-corrodible steels at the prices now ruling for the present rusting variety. It is only to be expected that the chemical industry is utilising non-corrodible and stainless steels to a very considerable extent, but when one realises that such steels could be used as containers for nitric acid, in addition to many other acids which would violently attack ordinary steel, it can be appreciated that the use of non-corrodible steels is of the greatest possible value to the industry referred to. A few years ago the use of such steel was limited, as it was not considered possible to weld it, but the problem was speedily overcome by the A. W. P. people, who produced a stainless steel electrode which gave entirely satisfactory results. It is not possible satisfactorily to weld stainless steel by using wire of the same specification as the metal to be welded, as a core for an electrode. The electric arc is a determining factor as it alters the composition of metals very materially, with the result that the metal deposited to form a weld may be found to be dangerously altered. Corners of vessels which have to be welded are particularly prone to be acted upon by liquids. If these parts are low in the metals which give the non-corroding effect, then speedy trouble may occur. It is necessary in consequence to use material for welding which has received the approval of stainless steel manufacturers. In this respect A. W. P. materials rank highest.

A New Method of Resurfacing Roads.—The use of cold bituminous emulsions for road spraying work is already well known, and the advantages of easier handling and fewer interruptions from the weather commend them to many highway surveyors and engineers. A new development, however, is the use of similar cold emulsions for remaking the roads with fresh metal, but this is a development which is now being introduced with successful results in Great Britain. Carefully graded road metal is mixed with the emulsion, spread on the road, and well rolled in. The binding qualities come into play very quickly and the road is ready for traffic in a few hours time. One of the difficulties connected with this method of road making lies in the mixing operation as the mixed materials are liable to clog in the mixer so as to prevent easy discharge. This difficulty has, however, been successfully overcome by Messrs. John Fowler and Co. (Leeds), Ltd., who have made special modifications in their concrete mixers, and after thorough trials are now able to offer them for mixing aggregates of this kind. One particular test may be mentioned which was carried out for an extended period near London mixing "Colasmix" for the production of the surfacing mixture known as "Colascrete." Each batch consisted of equal quantities (by volume) of 1 inch stone, ⅝ inch stone, and ¼ inch stone, down to dust, and this was combined in the mixer with suitable quantities of "Colasmix." The machine turned out an excellent mixture, the time allowed being from 45 to 50 seconds per batch, and the material was delivered to the barrows without clogging ready to lay the road coating 1½ inches thick. These mixers answer a dual purpose as in addition to cold emulsion mixing they can at any time be turned over to ordinary concrete mixing for kerbs, culverts, road foundations etc., and they are strongly built to stand up to the rough handling often meted out to machinery on road construction work.

Current News.

DR. W. BURNS has been appointed a member of the Indian Central Cotton Committee.

THE Simon Commission visited the Agricultural Bengal Farm at Gurudaspur on Tuesday last.

DR. G. DE P. COTTER has been appointed Palæontologist, Geological Survey of India, *vice* Dr. L. L. Fermor.

MR. J. H. THOMAS left England on 21st March for the Gold Coast where he will open the new harbour at Takoradi.

THE Royal Aero Club has awarded the South African, Lieutenant R. R. Bentley, the Britannia Trophy for 1927, for his long flight from London to Capetown.

A COMPANY has been formed in South Africa, with the title of the South African Radium Corporation, and a capital of £60,000, to work the pitchblende deposits of Cape Province.

THE total approximate gross earnings of State railways up to 3rd March 1928 amounted to Rs. 94·87 crores, or Rs. 443 lakhs more than the figures for the corresponding period of the previous year.

NICKEL chrome cast irons are, according to "Machinery," now being increasingly used for the making of automobile cylinder blocks, and it is only a question of time before they are used for other purposes.

THE constitution has been sanctioned of another Division in the 3rd Bahawalpur Circle, Sutlej Valley Project, to be named the Dallas Division, with headquarters at Rahim-Yar-Khan, from 23rd December 1927.

A MORE active policy of road construction is in contemplation by the Government of Uruguay, and probably later of State railway building also. The country is also being surveyed, with a view to schemes of afforestation.

THE number of passenger motor cars in Ontario in 1927 was 343,992, while the population is approximately 3,000,000. The number increases from 30,000 to 40,000 each year, the number of passenger cars in 1922 having been 210,333.

THE Portuguese Government has awarded to Duncan Stewart and Co., of Glasgow, the contract for the installation of a sugar refinery at Umbelugi, in Portuguese East Africa. The value of the contract is estimated at between £270,000 and £300,000.

THE asphalt street pavements laid last year in Warsaw by British engineers have proved so good that the municipality has decided to entrust British firms with all their paving work this year, and several other towns are likely to follow this example.

THE total approximate gross earnings of State railways for the week ending 3rd March 1928 amounted to Rs. 230 lakhs, Rs. 3 lakhs more than the figures for the last week and Rs. 21 lakhs more than the figures for the corresponding week of the previous year.

MR. J. REID KAY of Messrs. James Finlay and Co., Ltd., has been elected a representative of the Bengal Chamber of Commerce on the Calcutta Port Commission in place of Mr. J. A. Tassie of the same firm, who proceeded on leave for 8 months on 19th March 1928.

THE Railway Board have sanctioned the construction by the agency of the South Indian Railway of a line of railway of 5 feet 6-inch gauge from Salem to Mettur Dam *viâ* Macheri, a distance of about 26·80 miles. The project will be known as the Salem-Mettur Dam Railway.

OFFICIAL estimates place the available merchantable stand, including saw material, pulpwood, poles, cordwood, etc., of Canada, at 246,000 million cubic feet, which is roughly 100 times the annual cut for all purposes, and 50 times the annual cut and wastage—through fire and insects—combined.

THE railway systems of Mexico comprise 16,714 miles of track, of which 13,670 miles are under Federal control. The system styled the National Railways of Mexico operates 6,952 miles of 4 feet 8½-inch gauge and 1,513 miles of 3 feet gauge. There are over 10,000 miles of standard gauge line in the country.

IN the first year of operation of the new Dominion Government Dry Dock at Esquimalt, British Columbia, the revenue collected amounted to 19,306 dollars, although the dry dock was not officially opened until 1st July. The total number of vessels docked during the year was 18, with a tonnage of 86,480.

A SPECIAL feature in the Japanese Imperial train, which is being built to convey the Emperor Hirohito to Kyoto for his coronation this year, will be a special car for the transportation of the Sacred Sword of the Empire. This sword, together with the Sacred Jewel and the Sacred Mirror, constitute the divine relics of Imperial Japan.

BLAIR AND CO., and other American bankers, are reported to be negotiating a $100,000,000 (£20,000,000) Polish railway loan. The chief obstacle is said to be the difficulty of working out a satisfactory lien for the issue in view of the existing liens on the earnings of the railway. There are over 12,000 miles of railway made up of lines formerly part of the national railways of Russia, Germany and Austria.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

REINFORCED CONCRETE IN THE PUNJAB.

SIR,—His Excellency the Governor inspected the Government School of Engineering at Rasul recently and took interest in the Special Class in Reinforced Concrete construction.

Recent experience of the construction of a bridge of some size on the Grand Trunk Road did not show that this material was in every case more economical than brickwork; but elsewhere, as on the Sirhind Canal and in the Nili Bar, work in reinforced concrete was being widely adopted. An engineer's note on the experience gained in these localities would be sure to be interesting. There are wide stretches of the province in which the choice lies between brickwork and reinforced concrete and in most areas salts are prevalent in the soil, which quickly destroy brickwork where moisture helps them to creep into it. Is reinforced concrete better able to withstand the attacks of "kullar?"

ENGINEER.

Literary Notices.

Electrical Engineering Economics.—A Study of the Economic Use and Supply of Electricity. By D. J. Bolton, B. Sc., A. M. I. E. E., Lecturer in Electrical Engineering, The Polytechnic, Regent Street, W., Author of "Electrical Measuring Instruments and Supply Meters." London: Chapman and Hall, Ltd. 1928. Price, 21*s*. net.

This is a valuable work for all electrical engineers and will meet with appreciation. The author in his preface writes :—There is no need to stress the importance of a knowledge of economics to practising engineers at the present day. Many of the decisions which have to be made concern costs quite as much as performances, and items such as interest and depreciation have to be considered, as well as strength of materials or magnetism and electricity. In fact, to be fully qualified, the engineer can no longer be content with a knowledge of the properties of matter—he must also know something of the reactions of his fellow creatures. But even when recognising this fact, engineers (like the economists themselves) have been prone to dwell almost exclusively on the economics of production, with the result that most of the books on this subject have dealt only with production problems—costing, price fixing and works management economy—themes which are not touched upon in the present volume. There would therefore appear to be a real need for a book dealing more particularly with what may be called consumption economics, especially as it is in the consumption that the greatest waste occurs; and clearly it is no use taking great trouble to save a fraction in the power house, only to squander it wastefully in the workshop or the home. The manufacturer *per se* is naturally concerned only with efficient production without any consideration for the efficient use of what has been produced, but the engineer has to use plant as well as make it, and it is in this sphere of economic utilisation that he is apt to fall short. The physical characteristics (such as strength and output) of a proposed installation are understood fully and exactly, but when it comes to the *economy* of the performance he is too often content with a categorical "cheap" or "dear." It must not be forgotten that cheapness, like efficiency, is a matter of degree, and any tendency, however good in itself, has an economic limit beyond which it should not be pushed. One of the objects of the present book is, then, to attempt, in a few cases occurring to the user of electrical plant and energy, to answer the question "what is cheapness?" in any sense of that much-abused word. It is intended to enable engineers and others to find what precisely is the total cost of some given electrical service and thus to compare alternatives. In this way it is hoped finally to pave the way towards a complete set of economic criteria for the design and choice of engineering plant. In brief, the aim of the book is to give to electrical engineers and students a plain account of such elementary economics, as most nearly concerns them, together with its application to certain engineering problems.

Foreign Notes.

American Output of Motor Vehicles, 1927.—The American output of motor vehicles in 1927 amounted to 3,393,887 units. This was the smallest output registered by the U. S. automobile industry in five years, showing a decrease of 21 per cent. from the peak year, 1926, and of 20·4 per cent. from 1925. Passenger-car production totalled 2,938,868 units, a decline of 22·8 per cent. from 1926 and of 21·8 per cent. from 1925. The output of trucks in 1927 was 453,019 units, a drop of 7·5 per cent. from the preceding year and of 10·3 per cent. from 1925, which was the record year for truck production.

The Corrosion of Iron and Steel.—In a paper under the above heading, which was to be read before the Institute of Marine Engineers (Inc.) on 14th February, by Messrs. W. B. Lewis and G. S. Irving, it is shown that the chief type of corrosion in steam boilers is due to differential-aeration. When iron is placed in a solution of salt, action goes on to a small extent and chloride of iron and caustic soda are formed, plus a thin film of hydrogen over the metal. If air is present in the solution the hydrogen is gradually oxidised to water, and the chloride of iron reacts with the caustic soda to produce iron hydroxide which is deposited on the plate as a rust. So long as oxygen is supplied in the form of air corrosion will steadily go on underneath the rust. The necessity of taking the opportunity to remove the corrosive material from the tubes, combustion chambers and plates, particularly the loose deposits, whenever a boiler is opened up, is stressed.

The Port of Cartagena Improvements.—The Colombian Ministry of Public Works will shortly place a contract for important improvement works at the port of Cartagena, on the Caribbean Coast, considered to be the best harbour on the north coast of South America. The harbour is formed by a natural deep indentation of the coast line, shut in by two long islands lying parallel to the mainland, which affords deep and secure anchorage. The work will include the widening of the harbour at its mouth and the deepening of the channel leading through Cartagena Bay to afford access to the largest vessels visiting the port. The absence of modern quays has hitherto prevented vessels from approaching within a mile of the landing stages, the long railway pier on the mainland opposite alone permitting of vessels mooring alongside. There is keen competition for this contract between representatives of various European and United States firms, since it is understood that the successful contractor will not be required, as in many previous cases, to contribute any capital towards the carrying out of the project.

A Krupp Electric Locomotive.—The Krupp Company, in conjunction with the firm of Garbe, Lahmeyer and Company, is reported to have devised a new compensated single-phase motor, without a commutator, which is claimed to combine the good working properties of the three-phase motor with the advantages of the single-phase system with regard to "collection," and is therefore of great importance for railway working. After the new system had been tried on a trial locomotive, two shunting locomotives were built for the German Dye Trust, one of which has been in service for some time past at a lignite mine in Central Germany. The economic importance of the technical innovation is said to lie, in the first place, in the circumstance that for railway working the current can be taken from the general power network, whereas in the case of other systems (direct current or low-frequency alternating current) special power stations, or convertor stations, are necessary, with special distributing plant. It is calculated that through dispensing with special distributing systems, about 30 per cent. of the cost of electrification of railways will be saved.

Hot Bulb Engines.—One of the reasons that retarded the development of hot bulb engine construction in France was the high scale of duties imposed on oil fuels, and it was only after the war, when the importance of prime movers of this type was fully recognised, that the duties were reduced sufficiently to encourage the use of gas, oil and similar fuels. Makers of such engines are therefore alarmed at the character of the new tariff which is now before the Chamber of Deputies, whereby the import duties on petroleum products are adjusted with a view to the development of the oil refining industry in France. There is to be a considerable reduction in the import duties on oils that are to be refined in this country, but as the loss of revenue from this source must be made good in other ways it is proposed to increase the duties on oil fuels to an extent that, it is affirmed, will practically eliminate all hope for the future of the heavy oil engine. Manufacturers of such prime movers are, therefore, making a vigorous protest against raising the duties on fuel oils and suggest that the deficit could be easily made good by a further small increase in the duties on lubricating oils.

The Bauer-Wach Exhaust Turbine Drive.—Messrs. William Beardmore and Company, Limited, Dalmuir, have received an order from the Anchor Line for the conversion of the vessel "Britannia" to the Bauer-Wach system of exhaust turbine drive. The "Britannia," which has only been in service for about two years, is oil-fired and fitted with a quadruple-expansion engine, supplied with superheated steam, and developing about 4,800 i. h.-p. One of the great advantages of the system is that it can be fitted to existing vessels at relatively small expense, and a considerable increase in power, or, alternatively, a reduction in fuel consumption, can be attained. The turbine, which is a small high-speed unit, drives the propeller shaft through toothed gearing, in which is embodied a hydraulic clutch. This turbine and clutch are only in operation when the vessel is steaming ahead on a long, uninterrupted run; they are put out of action in astern running and manœuvring, when steam from the main reciprocating engine passes directly to the condenser. It is anticipated that the new equipment will reduce the fuel consumption of the "Britannia," already an economical vessel, by 15 per cent.

Electric Crop-drying Tests.—Some tests on the drying of grain by means of electricity have been recently carried out by the Royal Swedish Waterfalls Administration. The method adopted embodies the invention of Mr. H. Edholm, an official of the Administration, which has placed the funds required for the practical tests at the disposal of the inventor. The testing equipment had a capacity of about 8 tons, and consisted of a fan in connection with an injector and a discharge tube which, at the upper end, opens out on to a certain number of inclined boards for the airing of the grain. The air current from the fan forces the grain gradually up through the tube and on to boards which are inclined at an angle closely approximating the friction angle of the grain, which descends slowly towards the silo. The air current used to raise the grain is in the meantime carried off between the boards. The arrangement is such that the grain can be circulated once a day, or more frequently, according to requirements. The tests showed a consumption of from 2 to 3 kwh. per 2 cwt. of grain dried to within 16 or 17 per cent. of its water content, a figure which, it is considered, brings the process within the scope of small and medium-size farms.

Television.—A television experiment recently carried out by Mr. T. L. Baird, between this country and America, is said to have proved successful, says "The Engineer." The transmitted images of "sitters" in London were received at Hartsdale, a village outside New York, and although the images were crude and broken, the results came up to expectations. Movements made by the "sitters" in London could be observed in America. Considering the low power of the transmitter and the simplicity of the receiving apparatus, Mr. Baird is satisfied with the performance, and considers that with more power the results might easily be improved. Whilst the studio is in London the transmitting station is at Purley and a land line between these two places formed the first link in the route, the remainder of the distance being covered by wireless. The images were transmitted on a wave length of 45 m. Owners of wireless receivers can pick up television transmissions in the form of sound, which is different for every kind of object. Movement of objects cause changes in the sound, so that a man can be heard turning his head or opening his mouth. Mr. Baird has also been engaged for some time past upon the development of an invisible searchlight, and arrangements are being made for the installation of his apparatus on one of New York's skyscrapers for the purpose of showing how the invisible ray can be used to detect aeroplanes.

Energy Losses in Arc Furnaces for Steel-Making.—The Steel Works Committee of the Association of German Ironmasters has been investigating the energy losses incurred in producing steel in electric arc furnaces. The summary given by Herr St. Kriz, in "Stahl und Eisen," is based, not upon single runs, but upon a large number of runs made in different furnaces of the same type. It is found that about 39 per cent. of the electrical energy of the supply is lost during the melting of the charge, and about 63 per cent. during the refining of the steel. The component losses are estimated as follows:—The transformer (iron and copper) losses average 3·3 per cent. of the energy supplied to the transformer; 6 per cent. of the energy leaving the transformer is lost between the transformer and the electrodes; the cooling water of the electrodes carries away 4 per cent. of the energy during the melting period and 7 per cent. during the refining period. The closed furnace loses 15 per cent. through heat conduction and convection during the melting period and 29 per cent. during the refining period, mainly through the arches, and there are, in addition, radiation losses of 7 per cent. in the former and 11 per cent. during the latter period through the open door and other openings. The heat losses from the walls increased as the furnace charge was raised from 4·5 to 8 tons, and the gases carried 4 per cent. and 7 per cent. respectively of the heat away.

Electricity Supply at Chicago, U. S. A.—In a paper by Mr. E. C. Williams, printed in the "Journal" of the American Institute of Electrical Engineers, an interesting account is given of the interconnected power systems in the region surrounding and including Chicago. It is estimated that by 1930 there will be a population of nearly 5 millions within a radius of 50 miles of Chicago, and the demand for electrical energy in that region exceeded 4,000 million kwh. in 1926. It is served by four companies, of which the largest (Commonwealth Edison) has generating plant of 1,055,560 kw. capacity, two others having 237,790 and 46,825 kw. respectively. During the next two years additional plant of 352,000 kw. is to be installed, when the Crawford Avenue station will have a capacity of 424,000 kw. Plans are being prepared for a new station on Lake Michigan, which will have an ultimate capacity of a million kw.; it will be jointly owned by four companies. The first generating set, to be completed next year, will be of 200,000 kw. capacity, and will consist of three turbo-generators—one working at 650 lb. steam pressure, and two low-pressure sets; any one of these three can be taken out of service and the others kept in operation. The station is to contain five sets of this type. The generator busbars will be out of doors, and enclosed in metal; they are to be arranged in a double ring, comprising three sections, and the generating pressure will be 22,000 volts. There will be no line busbars, transformers being installed integral with each individual line.

High-Capacity Coal Wagons in Germany.—The "Railway Gazette" states that an instructive article on some new high-capacity coal wagons introduced in Germany for conveying coal from the mines in Upper and Lower Silesia, and the Ruhr to the Berlin works, is published in the February issue of "The Great Western Railway Magazine." These wagons are constructed of silicon steel and carry 60 metric tons of coal, with a tare weight of 19 tons. They are equipped with roller bearings and are of a somewhat unusual type of construction. In connection with the use of these wagons, the Reichsbahn has introduced a reduced tariff, provided that 800,000 tons of coal passes within 12 months in equal monthly quantities, that the traffic is loaded in standard high-capacity wagons, forwarded in train loads of not less than 1,000 tons, and passes to one responsible consignee. The advantage of the wagons to the railway will be manifest from the fact that a train load of 1,020 tons formed of 17 of the new wagons has a total length of only 190 yards against 630 yards covered by 68 vehicles of 15-ton capacity, while the traders obviously benefit by the reduction in rates. The journey from Upper Silesia to Berlin, 625 miles, including loading, weighing, clearance and unloading, is completed within 48 hours. Many other advantages are claimed for the use of high-capacity wagons of this character where there is a regular and concentrated traffic, and, as will be recalled, the Great Western Railway, in connection with their South Wales coal traffic, some time ago adopted a reduced tariff on all coal conveyed in fully-loaded 20-ton wagons.

General Articles.

LATEST TYPE OF MECHANICAL STOKER EQUIPMENT AT BARKING.

In connection with the new superpower station at Barking, London, we are able to reproduce on the opposite page an extremely interesting photograph showing the combustion chamber of one of the "Yarrow" boilers at this station, as equipped on the very latest principles with the new twin chain "Underfeed Type L" travelling grate stoker, the "Usco" suspended firebrick arch, and also a square weldless steel water cooling box at the side of the chamber to prevent the adhesion of clinker, operating in series with the boiler. These "Yarrow" boilers at Barking having a normal evaporation of 68,000 lb. of water per hour, with an overload up to 102,000 lb. and the stoker has a nett effective width of 19 feet, this being allowed of course without the slightest difficulty because of the suspended arch, which enables 30 feet and over to be used. Also, the amount of coal burned on normal duty is 10,000 lb. per hour, with an overload of 16,000 lb., that is corresponding respectively to 30 lb. and 49 lb. per square foot of grate area.

The new "Underfeed Type L" stoker has already been described in these columns, and the photograph shows very clearly the twin independent chains as fitted in all cases for a total width of 15 feet, or over, and the very narrow dead plates between, with the loose links lying back on one another forming the grate surface. It will be remembered that some of the chief features of this new stoker are the facts that no riddlings or dust whatever can get into the windbox, the air supplied is absolutely even underneath every part of the grate, no matter what the width may be, while any slight burning of the links does not alter the effective air space since the angle at which they live on one another is merely altered automatically.

Further, the "Usco" suspended firebrick arch is also familiar, consisting of a series of special interlocking firebrick blocks attached overhead steel girders, allowing any width to be constructed without difficulty and eliminating also the troubles due to expansion and contraction, the photograph being an excellent example of this principle as applied to mechanical stoking.

Very interesting also are the square weldless steel water-tube boxes which are fixed, as seen, along the bottom of the combustion chamber wall, just above the chain grate. As stated, these prevent any clinker sticking to the wall of the chamber, and the particular boilers at Barking have now been operated for several months continuously without any trace of clinker having to be removed. In the burning of bituminous coal, especially of a high volatile character, it is well known that with chain grate stokers there is always a tendency for a certain amount of clinker to stick to the walls just above the grate level, the projection growing sometimes to as much as 12 inches thick in three or four hours in bad cases, necessitating almost continual attention with a slide bar. Not only is the operation of cleaning in this way both difficult and exhausting, especially with a large stoker, but it is also very bad as regards wear and tear on the brickwork, and it is certainly very anomalous practice to have a mechanical stoker operating which still requires hand labour of this character, so that the above design of water-cooled box is itself a most interesting advance, especially when—as already indicated—there is now no necessity whatever to clean out dust and riddlings from the wind-box, either by hand or by the still more unsatisfactory complicated mechanical gear.

THE BRITISH INDUSTRIES FAIR.

INTERESTING EXHIBITS AT BIRMINGHAM.

(BY AN ENGINEERING CORRESPONDENT.)

LONDON, *1st March 1928.*

THE ninth annual British Industries Fair (Birmingham section), which was held in the great exhibition buildings at Castle Bromwich in February was of a record size, and fully justified the hopes held out of attracting large numbers of influential buyers and business men from overseas to this Midland city.

The Birmingham section, where the products of the heavy engineering trades were shown, was first established in 1920, and has steadily developed year by year in both size and importance. Last year it was found necessary to build extensions enlarging the area by one-third, and this year still further extensions have been required, until now a floor space of more than 10 acres is enclosed under one roof. This is the largest exhibition building under one continuous roof in the United Kingdom,—perhaps even the largest in the whole of Europe.

The City of Birmingham, which has been correctly termed "The Workshop of England," lies in the very heart of the great industrial Midlands, and in this section of the Fair were displayed thousands of exhibits demonstrating the industrial enterprise of the manufacturer and the skill and craftsmanship of the British workman.

ELECTRIC LIGHTING PLANTS FOR FARMS AND COUNTRY HOUSES.

Quite a large number of exhibits were shown in operation, and the advantages of this method of display were fully recognised by the visitors, and put into practice, wherever possible, by the exhibitors. Two types of electric lighting plants were shown in operation by Messrs. R. A. Lister. These sets are compact and easy to install, and form an ideal solution of the lighting problems for country houses, farms and outbuildings; while they can also be used for working a variety of domestic labour-saving devices.

VARIOUS EXAMPLES OF INDUSTRIAL TRUCKS.

Another important product of this Gloucestershire firm, the Autotruck, was also shown in operation. Three of these trucks were, in fact, employed in the Exhibition delivering goods and parcels to the various stands, and proved their efficiency, adaptability and ease of handling in congested areas. Since they are driven by petrol engines they enjoy this advantage over the electric industrial truck, in that no delay for battery charging is experienced, and they can thus be kept continuously employed.

In addition to the trucks in use in the buildings, three examples of the different kinds of bodies which can be fitted to suit any particular requirement were shown on Lister's stand. These included a road model, used for such purposes as the delivery of milk from house to house in suburban districts; an elevating platform model, where a low loading line is needed, and a swivelling tipping body for the handling of such loads as coal, gravel and the like.

THE ELECTRIC INDUSTRIAL TRUCK.

The electric industrial truck was also made use of by the authorities for transporting exhibitors' goods from the railway sidings adjoining to the stands within the building. The electric trucks used for this purpose were the well-known "Greenbat" models which, as their name implies, are manufactured by Messrs. Greenwood and Batley, of Leeds. These enjoy considerable popularity among large industrial concerns and railway companies both at home and overseas.

An electric truck capable of dealing with a load of two tons was to be seen on the stand of Ransomes, Sims and Jefferies, Ltd. This model is steered on all four wheels, and is intended for use where a low loading line is required, and the smallest possible turning radius essential. The elevating mechanism,

which is of a very rigid type, and has been specially designed to withstand continuous hard wear, is quite capable of dealing with the full platform load of two tons; while the elevating gear is fitted with automatic knock-off gear, so that it is impossible to over-run it in either direction. Another valuable feature is the simplicity of control and the consequent fact that skilled labour is not required.

Electric Lawn Mowers.

Among the wide variety of lawn mowers exhibited by Ransomes, Sims and Jefferies, who by the way are the pioneers of these machines, was an interesting example of the electric mower. In this case the current, either alternating or direct, is supplied to the motor by means of a flexible cable. The machine is set to work at the correct cutting speed, *i. e.*, about 3½ miles per hour, and this pace remains constant both up and down inclines. The cable is prevented from catching or fouling the machine by means of a cable arm which distributes it to either side of the mower as required.

The Motor Lawn Mower.

Messrs. Dennis Bros., the manufacturers of the famous Dennis commercial motor vehicles, were showing motor lawn mowers in which a number of new features have been incorporated. These include a more powerful engine, with cast iron piston, a crankshaft made from a one-piece stamping, large bearing surfaces and forced feed lubrication from a submerged pump. The machine is driven by a 4½ h.-p., two-stroke engine, which, besides being easier to start and more silent than the usual two-stroke, possesses the additional advantage that it can be run at a lower speed.

In discussing export trade with a representative on this stand the writer was informed that the demand for these machines from such countries as Australia, New Zealand, South Africa, Jamaica, etc., is exceedingly brisk.

Contractors' Machinery and Motor Locomotives.

A working model of a narrow gauge motor locomotive suitable for contractors and plantation use was exhibited by Messrs. John Fowler and Co. of Leeds; as well as some model trucks for contractors' work. But the main portion of this stand was taken up with a variety of constructional machinery such as concrete mixers, hoisting mixers, contractors' hoists, etc. The 7/5 concrete mixer shown is a development of the older 6/4 type, and incorporates a number of new features which improve the handling of the materials and give even better results in the concrete produced. A patent vibratory device ensures rapid and complete discharge of the loading skip, for by these means the skip is made to oscillate when in its topmost position so that the charge is emptied out as completely as possible. The mixer is operated by a 3 h.-p. Petter paraffin engine; and, in the case of the hoisting model, a 5 h.-p. engine of the same make is employed.

Oil Engines for Farms and Estates.

These "M" type engines, which were among the wide range of oil engines and generating plants shown by Petters Ltd., can be supplied for running on either petrol or paraffin; in the latter case a small quantity of petrol is used for starting purposes, after which the engine automatically changes over and runs on paraffin. The engines operate on the Petter two-stroke cycle, and are thus without the usual poppet valves or valve mechanism, the most frequent cause of trouble in small engines. Owing to their simplicity, strong construction and trouble-free running, these engines are ideal for use by unskilled labour. The "M" type series includes sizes of 1½, 3 and 5 b. h.-p., both stationary and portable, suitable for all small power purposes, such as the running of builders' and contractors' plants, as well as for farm and estate work.

Of the range of "C2" type heavy oil engines manufactured at the Ipswich works of Petters Ltd., a 70 b. h.-p. model (arranged for belt driving) was exhibited. These engines have been developed to meet the need for an engine in moderate and larger size powers, to give Diesel-like economy in fuel and lubricating oil, combined with the great simplicity of the semi-Diesel type of engine. Sizes from 25 to 600 b. h.-p. are manufactured by this firm, and these "C" type engines are noted for the fact that they will operate satisfactorily on the cheapest grade of fuel oils.

Surface Combustion of Gas.

An extremely interesting exhibit of Cox's Ignite Combustors, for the surface combustion of gas was shown by the Metropolitan Fuel Co., Ltd., the majority of which were to be seen in actual operation. The applications and uses of this combustor are practically universal, and comprise the whole range of industrial and domestic heating purposes; for it can be made to any size and shape, either regular or irregular, and thus provides a means of closer effect than can be obtained in any other way.

The example shown of some of the various uses to which this method of heat treatment can be applied included a glass demonstration water tank fitted with silica tube and two combustor burners; four sizes of soldering iron heaters; a thermostatically controlled enamelling oven; various sizes of combustor bricks; a metal melting pot, and two furnaces for annealing, etc. The advantages of this method for the heat treatment of metals include easy control and regulation of temperature, almost instantaneous and uniform heat, non-oxidising atmosphere, as well as the effecting of economies in gas consumption, and the lengthening of the life of the furnace.

Non-Ferrous Metals.

Extensive exhibits of non-ferrous metals in every shape and form were to be seen at Castle Bromwich, for Birmingham is the centre of this important industry. The Delta Metal Co., who are the pioneers and original patentees of the process of extrusion, and who it is understood manufacture more extruded rods and sections than any other firm in the world, displayed a large variety of specimens of extruded work. These included examples of rods, sections and tubes in all sorts of sizes and shapes in brass, manganese bronze, copper of both high conductivity and firebox quality, as well as stamping metals in various qualities, white metal and silver bronze.

This latter metal is a great improvement on plated metal work, for the fine silver colour runs right through it, whereas it is quickly worn off in plated metal. The Delta Bronze No. IV, famous for its great strength, resistance to corrosion and beautiful colouring was shown to advantage for it was the principal metal used in the construction of a most artistic pavilion, which occupied the centre of the stand.

Dust Collectors for Power Houses.

One of the two models of Davidson's Patent Flue Dust Collectors exhibited was shown in operation on their stand, and, in view of the general interest these days in the question of smoke abatement, attracted considerable attention. The Davidson collector, which was placed on the market about four years ago, has proved itself to be an eminently successful means of extracting the dust from the flue gases, and thus preventing that pollution of the atmosphere, which at one time seemed to be a natural corollary of the factory chimney. Four hundred of these plants have been supplied by the makers to various industrial concerns, the total collecting capacity of which amounts to no less than 300,000 tons of dust per annum.

A representative selection of the well known "Sirocco" fans were also shown on this stand, and visitors were thereby afforded an excellent opportunity of inspecting their design and construction, as well as the special features possessed by each of the types manufactured by this Belfast firm.

THE LARGEST GROUP OF ELECTRICAL ENGINEERING FACTORIES IN THE WORLD.

One of the largest stands at the Exhibition was that occupied by the General Electric Co., Ltd. Here were displayed typical examples of the products of the twenty factories owned by this firm.

The group of G. E. C. factories situated at Witton, are quite close to Castle Bromwich, consequently only a few exhibits, forming a mere skeleton of the output of these works, were shown; since buyers were given every opportunity to include a visit to Witton in their programme.

The examples displayed from the Witton works, which by the way are claimed to be one of the largest groups of electrical engineering factories in the world, included a 60 h.-p. "Witton" synchronous induction motor; a two-motor all-electric traction control equipment in operation, and a 240 h.-p. railway motor, as well as a 10 h.-p. high torque squirrel cage motor.

It was interesting to note that the flood lighting of the car park, near to the main entrance, was supplied by the G. E. C.

THE PYRAMID KENNEDY FORMULA.

I.

THE design, construction, and measurements, of the Great Pyramid, certainly follow a settled plan, which can be read off by study in the same general manner as hieroglyphs are deciphered.

The most important equation appears to be:

$$f_p = \frac{3\,(x+5)}{x+12}$$

Whence, naturally :—

$$V_o = C_o\sqrt{m_p} = C_o \times \sqrt{f_p} \times \sqrt{y}$$

the last connecting all channels having the same f_p.

The first question the writer tried to answer was: Does the C_o of the above formula apply to all values of f and therefore of m in the same rigid conditions of flow? May it, or may it not, be applied as in the "Factorization" articles, table B (second part), table D, and table E, and its deductions, or as in the "Kennedy Formula" articles, tables A and C in particular? The reply would appear to be *probably* in the affirmative; but extended observation has yet to show the exact truth. If such a series of f values as :—

$$f = \frac{3x}{x+12}$$

in precisely similar all-other conditions of flow, has the same C_o as the f_p series in like conditions, the thing is proved. But see table B.

The writer worked out the V_o of both kinds for Kennedy's 24 sections in the Panjab, Sind, California, Madras, Burma, for the Rio Negro, and in Egypt (foot measure) by the data given in the "Factorization" articles. They are very curious, but the sections follow no regular series in design or dimension, and they cannot, as a consequence, be compared in factorized units. The tables inserted below bring out the same facts better than anything else the writer could present.

TABLE A.

d	$C_o = 0{\cdot}8998$. $V_o = 0{\cdot}63\,d^{\cdot 64}$				$C_o = 1{\cdot}000$. $V_o = 0{\cdot}70\,d^{\cdot 64}$			
	f_p	m_p	x	V_o	f_p	m_p	x	V_o
2	1·786	1·191	5·30	0·982	1·785	1·190	5·28	1·091
3	2·000	2·000	9·00	1·273	1·999	1·999	8·98	1·414
4	2·168	2·891	13·24	1·530	2·167	2·889	13·21	1·699
5	2·308	3·847	18·35	1·765	2·307	3·845	18·30	1·961
6	2·429	4·858	24·78	1·983	2·428	4·856	24·71	2·204
7	2·536	5·917	33·26	2·189	2·535	5·915	33·16	2·432
8	2·633	7·020	45·22	2·384	2·632	7·019	45·07	2·649

d	$C_o = 1{\cdot}201$. $V_o = 0{\cdot}84\,d^{\cdot 64}$				$C_o = 1{\cdot}400$. $V_o = 0{\cdot}98\,d^{\cdot 64}$			
	f_p	m_p	x	V_o	f_p	m_p	x	V_o
2	1·783	1·189	5·26	1·309	1·786	1·191	5·30	1·527
3	1·998	1·998	8·96	1·697	2·000	2·000	9·00	1·980
4	2·165	2·887	13·15	2·040	2·168	2·891	13·24	2·380
5	2·305	3·842	18·22	2·353	2·308	3·847	18·35	2·745
6	2·426	4·852	24·59	2·644	2·429	4·858	24·78	3·085
7	2·533	5·910	32·97	2·918	2·536	5·917	33·26	3·405
8	2·629	7·011	44·60	3·179	2·633	7·020	45·22	3·709

The above table takes for V_o the Kennedy Formulas for Sind, the Panjab (original), and California, all of which make 0·64 the d index, the constants alone varying. An attempt is also made to interpolate values for $C_o = 1{\cdot}000$. It will be noticed with interest that the values of f_p, m_p, and x, are identical for Sind and California. What has been done in the table is to work out *mathematically*, f_p etc., equating $C_o\sqrt{m_p}$ and "Kennedy's" formulæ.

The writer relies on tables A, B, and C (to follow), for proof of the P. K. equation. See table B below: it is plain that if Kennedy's formula in any shape is accepted by the profession, that one value at least of $C_o\sqrt{m_p}$ must also be correct for each d, as the accurate V_o. It is clear, also, that if engineers now incline to think that the width of a channel should be a factor in the calculation as well as the depth, that employing the hydraulic mean radius is a rational solution. It now remains only to be seen whether only one special set of values of f, as f_p, has a constant C_o; and whether all V_o series of f, have also each a constant C_o; and finally, whether in like conditions of flow the C_o is a constant for ALL values of f (in all cases for V_o and not on any account for miscellaneous v).

TABLE B.

d	V_0 for x, for d = (as shown)						
	2 5·26	3 8·96	4 13·15	5 18·22	6 24·59	7 32·97	8 44·60
2	1·309	1·386	1·442	1·488	1·527	1·560	1·589
3	1·603	1·697	1·766	1·823	1·870	1·911	1·947
4	1·851	1·959	2·040	2·105	2·159	2·206	2·248
5	2·069	2·191	2·280	2·353	2·414	2·467	2·513
6	2·267	2·400	2·498	2·578	2·644	2·702	2·753
7	2·449	2·592	2·698	2·784	2·856	2·918	2·973
8	2 618	2·771	2 885	2·976	3·053	3·120	3·179

The comparison is made with the well-established equation: $V_0 = 0{\cdot}84d^{\cdot 64}$, for V_0 underlined.

The main curiosity (if curiosity it be!) in the above table B is that V_0 for $d = 8$ is exactly double the corresponding V_0 for $d = 2$, being as $\sqrt{2} : 2\sqrt{2}$. Granted the theory, the preparation of the necessary tables presents no difficulty.

Σ. Φ.

Drafted in *November 1927*.
Revised *5th January 1928*.

THE RESTORATION OF THE ANCIENT IRRIGATION OF BENGAL.

BY SIR WILLIAM WILLCOCKS, K. C. M. G.

A lecture delivered at the British Indian Association Hall, Calcutta, on the 6th March 1928.

(Continued from page 154.)

10. Though I have been forced to sacrifice in this way on the altar of truth, I am no pessimist. I am an optimist of the optimists. And now I come to the remedy for all this deterioration and decay. The decay of both health and wealth is due to the fact that the country has been deprived of its rich red flood water. In Egypt we consider a red water famine as the greatest calamity which can overtake the country. Such a famine has overtaken both Central and Western Bengal. The real remedy is the restoration of the perfect system of "overflow irrigation," so well suited to Bengal. Wherever to-day we can see such irrigation we are in Egypt. Wherever to-day we can see water, the trees look fresh and the crops green; and they tell us that they will respond to irrigation. In Central Bengal we have 6,000,000 acres of land as level as a billiard table ready for the most perfect irrigation and constitute an asset worth £5 per acre in labour alone. There are about 1,000,000 acres of groves of mangoes, bananas, fruit trees and ordinary trees which would be improved indeed by red water irrigation and ordinarily by a rise of spring level. There are hundreds of miles of canal lined out with skill, which have adjusted themselves to the slope of the country and are well suited to overflow irrigation. There is an agricultural population of 8,000,000 of the same race as the agriculturists of Eastern Bengal who, under the guidance of the Agricultural Department, are facing with courage and enterprise the invasion of their fields by water hyacinth. Put hope into the hearts of these people and they will respond soon enough.

11. The way to begin is to pierce the existing chains of embankments at suitable points, notably opposite old channels, with numerous openings. Each opening to be 10 feet wide, open to the top, with iron horizontals and vertical wooden needles of the old Egyptian type, with a channel some 10 feet wide and some 2 feet deep leading from it for a mile or more to begin with. These openings will face the flood clean open and be regulated by needles if the flood is dangerously high. Leaks between the needles will not matter when the country is all under rice. A year's trial will teach all the lessons we need. Murshidabad and Nadia are the two hardest hit districts. Begin with them and clean all the old canals and make them workable. Water ran in the past in them and water will run again. Put on 30 engineers on the old canals everywhere to put boundary pillars on their limits and enter into possession of them and clear out all patent obstructions to begin with. This is a great national work. It is the resuscitation of the whole of the true Gangetic delta and is to be undertaken in the spirit of a national work. We are going to make Central Bengal live again. "My land shall no longer be called *desolate*, it shall be called *married*, for the floods shall marry her as a young man marries a virgin." This is the spirit in which we shall approach this work, for we mean success.

12. All the offtakes of the main canals are from the Ganges, and we now turn to them. If during the last 40 years the engineers had laid a bold hand on the Ganges and trained it by protective works so that all its weak canals or offtakes like the Bhagirathi, the Jelingi and the Matabhanga took off from well protected banks they would have remained as potential as they were when Bernier saw them. Weak offtakes cannot carry the coarse sand of the deep waters of the parent stream, but they are perfectly happy with the finer sediment of the surface waters, which, in well trained rivers, flow into them in a direction opposite to that of the main river. If the river bank is not protected upstream of a weak canal head, and a current sets on the bank and brings it down, all the earth which falls into the river makes the water full of silt as it passes the canal head, and this silty water settles in the bed of the canal or weak offtake and makes it still weaker. "Be sure of your canal head" was Alexander the Great's motto when he undertook the restoration of the fertility of ancient Babylonia. Geniuses like him are always right. We must make sure of ours. Vigorous offtakes like the Gorai and the Baral, on the other hand are a menace to the Ganges and threaten to become the main stream itself. They should be protected by massive stone wings and the Gorai should have accacia trees anchored at its head to weaken the supply entering it.

13. The Ganges is no bigger than the Mississippi and has less difficulties to contend with. The catchment basin of the Ganges is a long settled land and its discharges are fixed. On the Mississippi, millions upon millions of acres are being more closely settled and the rainfall on them is being sent more quickly to the river and adding for ever to the volume of its floods. This has turned the flank of the American engineers, who otherwise would have trained it as a spaniel. Every village or town should be protected beginning work at the downstream end. A few kilns of bricks built on the site and overburnt into monoliths with some stone pitching around them are very effective as spurs or protective work. It is a sickening sight going up and down the Ganges to see scores of miles of old trees and hamlets and beautiful gardens falling into the river and being engulfed. This is never seen on the Mississippi or the Nile to-day. It is a disgrace on the Ganges. This destructive action is increased on the Ganges, as it was on the Nile until we protected it, by the big steamers going up and down the Ganges, hugging the deep bends in winter and summer when the water is clear and has a cutting edge. It is just at these bends that the steamers should be far from the shore and it is just there that they have to be nearest. Stern wheels should be prohibited and screws or whatever is least disturbing insisted on. If action such as I have seen on the Ganges is not controlled immediately by training works, the Ganges will go out of hand and ravage the country. It will become a series of S^s and, latter on, cost ten times as much to protect. Fortunately for us on the Nile, our hands were forced by the thousands of tourists on the river, who cried shame on us when they saw trees and houses falling in, though the damage they saw to what I saw on the Ganges was as the bite of a flea

to the maul of a tiger. I saw a hundred times more destruction in a few days on the Ganges than I have seen elsewhere in the whole of my life. Villages, fruit trees, gardens and rich crops and ancestral trees situated on some of the hardest soil had fallen like ninepins into the tormented water as readily as had the trees on the more friable soil. Whatever pitching is used, it should be of different sizes mixed together, big and small even to pebbles. Such pitching is an effective protection for very sandy soil.

14. When the river is once trained and its banks protected, it will be possible to put up pumps on the banks and provide perennial irrigation to a distance of 20 miles from the Ganges. Modern pumps are very economical and effective. The water stored in pools, tanks and depressions will be found in this way a valuable asset of the country. At this stage the "overflow" canals will be beginning to show their value and it will be time to control the flood water of the Ganges and insure every year a full flood. This will be done by an Egyptian barrage at a point about 7 miles below the Baral head. Such a barrage could be built well within deep iron piles in one half of the width of the river protected from the highest floods and built in the dry and the river then turned over it. This Nadia barrage will have 180 openings of 25 feet each, 162 piers of 10 feet and 17 abutment piers of 20 feet each. It will have a length of 6,460 feet between abutments, with a lock. The piers will be 45 feet high and carry a roadway. The regulating apparatus will consist of Stoney gates fitted with vertical hit and miss sliding panels so that the current of the Ganges will be broken up into very many vertical fillets, and as the water will issue as through a comb it will fall its 6 or 7 feet at the time of flood with little action on the floor. Over the floor downstream of the barrage a flood of 2,000,000 cubic feet per second will pass with a depth of 40 feet and velocity of 8 feet per second which is the observed mean velocity of a Ganges flood at that depth. A flood of greater dimensions will be easily accommodated. The heading in flood at the piers will be about 3 inches. It will hold up in flood about 7 feet if necessary. The long weirs and barrages we have built in the past defeat their own ends, and, by forming islands, increase and not decrease the current. The floor will be 150 feet wide and the pitching upstream 100 feet wide and downstream 200 feet wide. Such a work will cost £12,000,000 with its training works complete. The delta of the Ganges is so conveniently deposited that one barrage will suffice for the whole of Central Bengal and the Bhagirathi as well, which will eventually have the Jelingi as its summer feeder. It will be possible to feed the Jelingi and Matabhanga in winter and summer by holding up 12 feet of water in low supply. The minimum discharge of the Ganges I calculate at 40,000 cubic feet per second. To enable me to do this calculation, Mr. Lawton kindly allowed me to plot all their measured discharges at the Hardinge bridge with the aid of Mr. Delanougerede and his draughtsman. There will never be need of any reservoirs.

15. When Sir Arthur Cotton proposed perennial irrigation for the Godavari and Kistna deltas he remarked that the funds for carrying out these works could easily be found by converting the waters of the rivers into money instead of letting them run into the sea. If the Ganges had not been such a big river the thorough irrigation of Central Bengal would have been undertaken long ago. And if the canals had not been called rivers and neglected and even injured by being deepened at their heads for navigation, the country would never have become the derelict country it has. The canals will first be resuscitated, and later on the barrage built; and Central Bengal will be richer than it was when its prosperity and salubrity made such an impression on Bernier. Egypt, by its formation, had to spend £5,000,000 on the Aswan dam and will have to spend £3,000,000 more on reservoirs or £8,000,000 in all. The Ganges needs no reservoir. Egypt has already spent £5,000,000 on barrages and is spending £2,000,000 to-day and will spend £2,000,000 yet on completing her barrages. She will have spent £17,000,000 in all for 6,000,000 acres. Central Bengal will be completely served by one barrage for 6,000,000 acres and the complete control of the supply of the Hooghly for Calcutta. £12,000,000 is a small sum for so large a programme of work.

16. For irrigation such as the overflow irrigation of Bengal, where the rich red water of the Ganges floods mingles with the poor white water of the monsoon rainfall in the ricefields which stretch from one end of the country to the other, we can have no measurement of individual fields, for such irrigation takes no count of individual fields. We can only have the irrigation cess of Egypt, where all benefit by the water on the land and under the land. Basin irrigation in Egypt and overflow irrigation in Bengal are one and have nothing in common with the perennial irrigation of individual fields. The Egyptian Government has never made more than 2 per cent. by direct taxation on the Aswan dam, and yet it has made millions by the increase in wealth of the peasantry and their power to spend money; while, owing to the insurance of irrigation, the price of land in Egypt rose almost immediately from 14 years' purchase to 20 years' purchase, or by 40 per cent., and has remained at this figure. The Government of India would have turned down the project. When reviewing for INDIAN ENGINEERING the work of the Irrigation Commission I noted that the Government of India never identified itself with the people of India, it acted as though it had no duties and no obligations to poverty-stricken people who were often poor owing to the ignorance of the Government itself. It accepted its obligations on rare occasions and on a very small scale. It was for this reason it turned down the most necessary projects for the wellbeing of those who were most in want of them, and delighted in reclaiming deserts where there were no poor to provide for. In Egypt however the Government and the people are considered as one; and, in the end, this unselfish outlook results in greater prosperity for both the people and the Government. Lord Cromer has proved himself a sound financier.

(To be continued.)

The Gazettes.

Punjab, March 16, 1928.

Buildings and Roads Branch.

Rai Bahadur Lala Amar Nath, Nanda, Sanitary Engineer to Government, Punjab, is granted leave on average pay for 8 months, with effect from 1st April 1928, or such subsequent date as he may be able to avail himself of it.

Irrigation Branch.

Mr. F. G. Beck, Temporary Engineer, on transfer from the Bhatinda Division, Sirhind Canal, which he left on 8th February 1928, joined the Delhi Division, Western Jumna Canal, on the 10th idem.

Mr. W. S. Hall, Assistant Executive Engineer, attached to the Weir Division, 1st British Circle, Sutlej Valley Project, is allowed leave on average pay for 8 months, combined with leave on half average pay for 4 months and study leave for 6 months, or total 18 months, from 8th March 1928, or subsequent date.

Lala Sundar Dass, Pahwa, Assistant Engineer, is transferred from the Okara Division, Lower Bari Doab Canal, which he left on 17th December 1927, to the Dallas Division, 3rd Bahawalpur Circle, Sutlej Valley Project, of which he assumed charge on the 22nd idem.

Mr. Gurbakhsh Rai Chopra, Temporary Engineer, on transfer from the Khadir Division, 2nd British Circle, Sutlej Valley Project, which he left on 17th February 1928, joined the Western Bar Division, 2nd British Circle, Sutlej Valley Project, on the 21st idem.

Lala Chetan Lal Jain, Assistant Engineer, on transfer from the Qaimpur Division, 2nd Bahawalpur Circle, Sutlej Valley Project, which he left on 10th February 1928, joined the Kirana Division, Lower Jhelum Canal, on the 17th idem.

Mr. H. W. King, Superintending Engineer, Lower Chenab West Circle, is allowed leave on average pay for two months and 21 days and in continuation leave on half average pay for 4 months and 24 days, from 7th April 1928, or subsequent date.

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INDIAN ENGINEERING.

SATURDAY, MARCH 31, 1928.

INDO-EUROPEAN TELEGRAPH.

THE Indo-European Telegraph Department is the only Department of the Government of India which has its headquarters in London and is administered directly by the Secretary of State for India. How that position arose and the reasons why it has continued were explained by Mr. Maurice G. Simpson, M. I. E. E., Director-in-Chief of the Department, in an interesting paper read before the Royal Society of Arts on 20th January last.

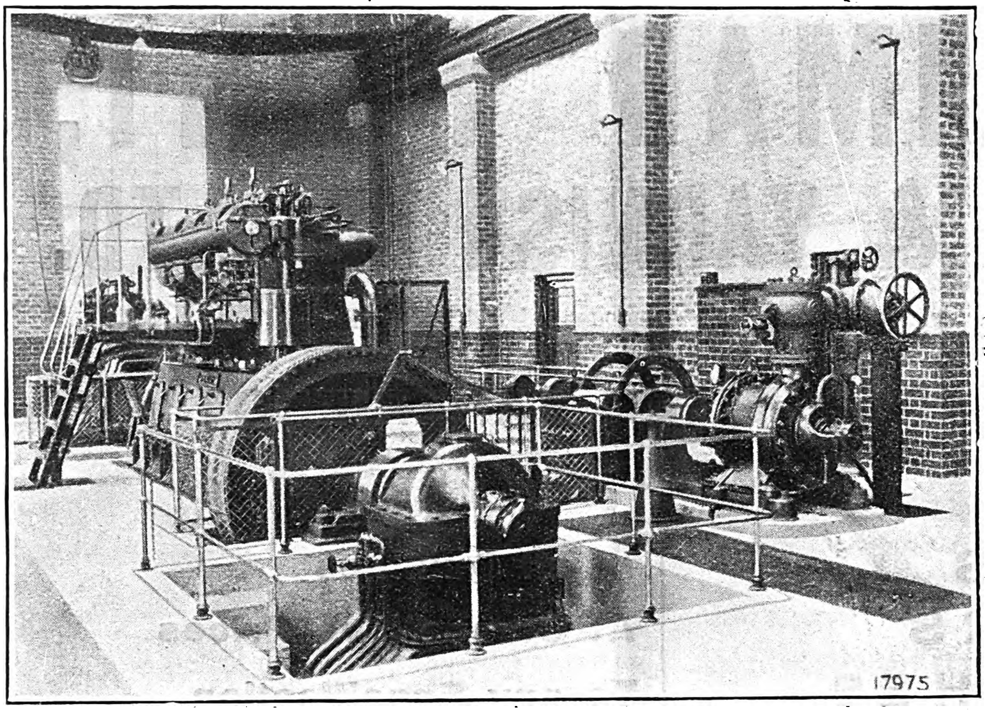
Telegraph lines began to be built in England in 1840 and in India in 1852. A connexion between the two countries was obviously wanted, but Turkey was always a difficult country to deal with, and after some negotiations the Turkish Government refused definitely to grant a concession, though it agreed to construct a line, employing British engineers for the work. This led to the employment of Lieutenant-Colonel Biddulph, R. A., who started operations in 1859. He withdrew from the project in the following year owing to the incessant difficulties caused by the Ottoman administration, but he left behind him three retired non-commissioned officers of Artillery, who stuck doggedly to their job and completed the line from Constantinople to Baghdad in 1861. In that year, the Government of India instructed Colonel Patrick Stewart, R. E., to survey the coast on the Persian Gulf side, and Colonel Stewart prepared a scheme for connecting Karachi with Fao at the head of the Gulf, which was carried out. Turkey completed the connexion between Fao and Baghdad in 1865, and then the first telegraphic communication between Europe and India was established. In the first month the number of messages was only 62, but this increased with rapidity. The charge for a telegram was then £5 for twenty or part of twenty words and the time of transit was 6½ days, against over a month for a letter to Bombay. Delays led to a demand for improvement of the service, and concessions being obtained from Germany, Russia and Persia, communication was established from London to Teheran and from Teheran to Karachi *viâ* Bushire in 1870. By that route the transit time was a little over 6 hours. In the meantime, submarine telegraphy had made great strides, owing largely to the genius of Lord Kelvin, and a little after the completion of the Indo-overland route a cable route from England to Bombay was completed. In 1871, there were three telegraph routes between England and India, the Turkish *viâ* Constantinople, the Indo-European *viâ* Germany, Russia and Persia, and the Eastern cable route to Bombay; and these with occasional interruptions continued in operation till the outbreak of the Great War in 1914.

The value of the telegraphic communication between England and India is shown by the way the number of messages continued to increase. In the year 1879-80

there were 42,487 messages; in 1889-90 there were 106,702; in 1899-00 the number rose to 152,837; and in 1900-01 to 274,092. With the commencement of the war, the lines through Europe were immediately put out of action, and Sir Rayner Barker saw at once the danger of Russia being cut off from wire communication with her allies by any of the direct routes to the west. The roundabout route *viâ* Bombay, Karachi and Teheran therefore became important. There were the two routes between Karachi and Teheran *viâ* Bushire and *viâ* the Central Persia line, but a third, *viâ* Mashad and Seistan, could be made available and this was completed in October 1914. Then, when Turkey entered the war, it was evident that the single cable between Fao and Bushire would be inadequate and a second line was laid. The Department was thus able to provide two comparatively safe lines which carried the whole traffic between Mesopotamia, the Persian Gulf ports and Persia on the one hand, and India, England and all parts of the world on the other. This traffic was very heavy, it amounted in 1918-19 to 660,000 messages, containing over 7,000,000 words, in addition to a very large number of messages relating to the sick and wounded which were carried free of charge. The telegraph engineers of the Department can therefore claim to have rendered invaluable service to the campaign in Mesopotamia, especially as the traffic was carried out without any serious breakdown or even undue delay. At the close of the war, action was at once taken to restore the line through Germany, Poland and Russia, and it entailed a vast amount of work. The restoration was completed in August 1923, after an interruption of nine years. The Department resumed the work for which it mainly exists, the transmission, in conjunction with the Indo-European Telegraph Company, of messages between Great Britain and India and countries beyond. To this is now added the traffic with Iraq, which before the war was transmitted *viâ* Constantinople. The total number of messages dealt with by the Department in the year ended 31st March last was just under 400,000.

The first head of the Department was Colonel Patrick Stewart who did splendid work for it in the early days. He had great abilities, zeal and enthusiasm, and it was sad that he should have died prematurely in Constantinople at the age of thirty-three, a few days only before the completion of the connexion between Europe and India. He seems to have had no fixed headquarters, he spent his time in harassing travel in the Persian Gulf, Persia and Constantinople, with visits to India and London, and he appears to have corresponded direct with both the Secretary of State and the Government of India. Colonel Goldsmid, who succeeded him, was also constantly on the move from London to Bombay, Karachi, Teheran, Constantinople as circumstances required. He was followed in turn by Major, afterwards Sir John Bateman Champain, and it was in his time that the question of headquarters was raised. The Government of India proposed Bombay, but Major Champain vigorously opposed this proposal. He pointed out that the interests of the line were intimately linked with those of the Indo-European Telegraph Company, he had constantly to consider questions affecting the Company and the Department, he had much correspondence with other telegraph administrations which could not be conducted from India without serious inconvenience and loss of time, there were matters which involved consideration of treaties which had to be dealt with in communication with the Foreign Office in London, and the principal traffic office had necessarily to be in London, where cash was received for all messages sent to India and the accounts were made up for the shares due to the several administrations. Major Champain was no doubt right, at any rate his arguments prevailed, and the headquarters of the Department were fixed in London, though the control of the Department was transferred from the Government of Bombay to the Public Works Department of the Government of India.

It is unnecessary to enter into the record of the various officers who followed Sir John Bateman Champain, but some allusion may be made to the good work done in arduous circumstances by the men in Asia, between India and Europe, especially in Persia. When Major Murdoch Smith, R. E., with a staff of three officers and twelve non-commissioned officers of the Corps and six civilians, was sent to construct the line in Persia in 1863, the whole country from the Shah downwards made the visitors feel that they were unwelcome. They were viewed with suspicion, they had hardships, so many obstacles were thrown in their way that success seemed hopeless. They nevertheless succeeded by reason of the tact, courage and loyal efforts they displayed, and they left the country good friends with those who had regarded them as anything but welcome guests. And that was not the only instance, the staff in Persia in later years suffered great deprivations. They had to repair lines, keeping on the heels of Afghan gun-runners who were wrecking them; they had often to work in a desolate no-man's land; to drink brackish water which was not fit to drink, eating anything that came their way, and sleeping on the ground. Many of them have been robbed by brigands and left almost or quite naked to struggle to the nearest village, and some were murdered. In the winter, the cold of the wind-swept plateaus is intense, and intense also is the heat in summer in the low-lying plains and desert. Mr. Simpson said that it was difficult to convey how great was the suffering and hardships that the staff endured, and that there was hardly a senior member who had not been through famines, epidemics, riots and other excitements of not too pleasurable a kind. In the Gulf section, if life had not been beset with the same alarums and excursions, the staff had nevertheless to serve in isolated coast stations and in desolate islands in one of the worst climates of the world. The fact therefore that the staff of the Indo-European Telegraph Department have served the Government of India with such unswerving loyalty in trying, difficult and sometimes dangerous circumstances deserves that it should be brought to notice. We in India, the operations of the Department being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almost entirely outside the boundaries of the country, have known very little of the work of a service which affords us telegraphic communication with the world, and Mr. Simpson's excellent paper gives us the necessary information to enable us to realise the position.

PANJAB IRRIGATION AFFAIRS.

In the present position of the Panjab, when the minds of irrigation officers are occupied with the special questions of relief from waterlogging in certain canal tracts and of storage reservoirs to supplement the supplies of water to the channels of the Sutlej Valley scheme, some little interest attaches to a paper contributed to the Panjab Engineering Congress fifteen years ago. The paper referred to was one by Mr. C. E. Blaker, Assistant Engineer, with the title "Auxiliary Reservoirs for Irrigation in the Panjab;" and in it the author dealt with the problems of impounding the flood waters of the rivers for extensions of irrigation and of remedial measures to combat the evils of waterlogging in canal-irrigated areas. The object of the paper was to suggest that the construction of reservoirs might prove to be the solution to both these difficulties, inasmach as the reservoir dams would not only impound water for extensions of irrigation but would also make available power for pumping water from the tracts of land where waterlogging had occurred. Whatever may be the opinion from the point of view of these aims, the paper was a thoughtful one for an Assistant Engineer, and it might almost be said to have been prophetic. The subject was doubtless indicated to Mr. Blaker from the circumstances of 1912-13, he assumed that with the completion of the Triple Canals project, water for future pojects might have to be obtained by means of storage, while as regards the waterlogging, it called for no assumptions, it was an evil then, and Mr. Blaker knew it to be an evil that would increase in intensity. The paper was therefore calculated to put the Panjab engineers on their guard. But what has happened? Fifteen years after Mr. Blaker wrote his paper, waterlogging is worse than it was before, and it has been discovered that there is every probability of shortage of water for the last new project, the Sutlej Valley, which is in an advanced stage of construction.

Regarding the waterlogging, it is admitted by the Panjab that the evil has assumed a serious aspect, especially in the areas pertaining to the Upper and Lower Jhelum and Upper Chenab Canals, and it is understood that a Superintending Engineer has been appointed on special duty to devise what may be necessary in the way of anti-waterlogging measures. The necessity for such an appointment is not very apparent, the reasons why waterlogging occurs are now tolerably well understood and the regular establishment should be able to cope with the situation. We have mentioned before, and there is no harm in mentioning it again, what Professor Richard R. Lyman said in his address before one of the International Irrigation Congresses in America. He said that if the work of irrigation is to grow, if out of it the greatest possible good is to come, it is essential to study and profit by the failures of the past. And what, he added, does the experience of the past teach? It is that practically everywhere more or less of the land is ruined by excessive irrigation. Water turned upon a desert leads to wealth in the present, but in course of time a good farm becomes a poor one, and a poor one in further time becomes useless and has to be abandoned. A small amount of a powerful drug helps the sick, and too much of it means death. A physician, unable to distinguish between the amount of a helpful and a murderous dose, would be regarded as criminally ignorant or neglectful, yet irrigators apply a medicine to their lands in the form of water without knowledge or apparent concern as to whether the dose is beneficial or harmful. Are there, the Professor asked, expert irrigation engineers who have the necessary information, or is water, the intrinsic thing in irrigation farming, handled and used and wasted in reckless ignorance. There is but one crop of land and it is a crime against future generations to injure it. Professor Lyman was speaking from his knowledge of America but his words have the same moral for India where there is also the liability to an excessive use of water, and it would not appear to be so much a question of ignorance—there is surely little excuse for ignorance at the present time—as of recklessness.

Every irrigation engineer knows that when a gravity supply of water is introduced into a tract the spring level rises, the rate of annual rise is also approximately known, and when the natural spring level is comparatively high, waterlogging must inevitably declare itself in no great length of time unless the dose of water is anything but a murderous dose. The gravity supply and the assessments by area have in the past been the mischief. In irrigating from wells cultivators will not lift more water than is absolutely necessary on account of the expense, and if in canal irrigation it were possible to charge for water by volume there would be the same incentive to economy. But in flow irrigation from canals there is no sort of incentive, and the cultivator in the hope that the more water the better crop pours on the water without stint. It is a human failing, and human also is the complacency of canal officers who like to see the extensive irrigation operations reflected in their annual reports as a source of pride to themselves. They are pulled up with a round turn when they see waterlogging staring them in the face, but if they then feel that they should curtail supplies, they find themselves in conflict with the civil officers who are reluctant to deprive cultivators of water to which by long usage they have acquired a sort of right. But human frailties have sometimes to be combated with a strong hand, and just as a good physician would refuse to permit the use of a noxious drug to a patient, irrigation authorities have to understand that it is a crime against future generations to injure land. If there is waterlogging, it should cease, and irrigation engineers know that betterment is the immediate result of making perennial irrigation

channels *kharif* channels only. The stoppage of *rabi* water, the bringing of wells into use if *rabi* water is desired, and unobstructed surface drainage will cure the disease. It may be an old-fashioned remedy, but it will be cheaper than and just as efficacious as heroic pumping schemes of immense cost.

The hunt for storage reservoirs concerns a problem of quite another kind. The Panjab in the waterlogging aspect appears to be suffering from too much water rather than from too little; but there is the special case of the Sutlej Valley scheme. The earlier projects were, it is believed, framed with due regard to the supplies available at the confluence of the Beas and Sutlej rivers, but the post-war project was faulty in its discharge statistics, and for that reason it is understood that it is now recognised that water will be insufficient for the areas the project was designed to irrigate. An effort is therefore being made to find suitable storage sites on the Sutlej and the Beas to save the situation. The matter is in the hands of a committee of engineers and the results of their deliberations has yet to be made known. But in any case the outcome can only be unfortunate and unsatisfactory, the Sutlej Valley project-estimate has already been twice revised, storage reservoirs on the two rivers concerned are bound to be expensive affairs, and at the best will affect very seriously the financial outlook. It is consequently a question whether it would not be the better alternative to accept the available supplies which, if they are deficient, will lead to economical use of water and prevent the evils of waterlogging in tracts where waterlogging is to be feared. In the projects of the past it has been the rule rather than the exception for water to be too plentiful, and when that is the case the results are rise of spring level, waterlogged land, saline surface deposits and ill-health of the people. It would be a welcome change to have a project with admitted water shortage, it would put canal officers on their mettle to ensure equitable distribution, not at exceptional periods of low supply but always, and it might from the very fact of enforced economy lead to duties of water the potentialities of which irrigation engineers have at present very small conception.

PROPOSED TELFORD MEMORIAL.

As a proposal had been made in the locality to erect a memorial to Thomas Telford at the place of his birth, near Langholm, Dumfriesshire, the Institution of Civil Engineers has thought it fitting to take part in the tribute to the memory of one of the greatest of British Engineers, who was moreover the first President of the Institution in 1820 and who continued to preside over the Institution till his death in 1834. The cost of the proposed memorial is said to be about £350, and the Institution invites subscriptions of any amount up to a maximum of ten shillings, with the aim to spread the sum subscribed over as large a number of subscribers as possible. The intention is that the memorial should take the form of a massive granite seat, with suitable inscriptions on bronze tablets affixed thereto, on the roadside at a point overlooking Meggat Water, at the head of which Telford was born in 1757. Telford may be said to be fairly typical of the humble origin of so many of the fathers of engineering in Great Britain. He was a son of John Telford, a shepherd on a farm in the valley of the Meggat, whose home was just a mud hut with a thatched roof. He died young and left a widow in charge of the only child of the marriage, a small boy destined to be the first President of the Institution of Civil Engineers. When young Telford was old enough to work, it was at first thought that he would be a shepherd like his father, but eventually he was put to learn the business of a stone mason, and a mason he would have been all his days if he had not possessed the natural genius of a great engineer. The ability and conscientiousness with which he carried out any building work entrusted to him led to the appointment of county surveyor, and from county surveyor he became the engineer of the Ellesmere Canal, a project involving much difficult engineering, including the large aqueducts, the Chirk and the Pont-Cysylltau, and two tunnels through hard rock. The successful completion of this work established Telford's reputation as an engineer and he never looked back. No form of engineering came amiss to him, he had no education as education would be considered now-a-days, he was self-taught, but then it would almost seem that engineering he did not need to learn because it was inborn in him. He constructed the Caledonian and other canals than the Ellesmere; he was an architect and designed the St. Mary Magdalen Church among other buildings; as a road-maker he was just celebrated and his roads were the best which up to that time had been made; he was, a great bridge-builder and designed many hundreds of bridges, both in masonry and iron, including the Menai and Conway bridges; and he was also a very skilled dock and harbour engineer. That is what he was, a leading engineer in Great Britain for a period of about forty years, a man of honour and integrity of character, and it is small wonder that the Institution of Civil Engineers should think it appropriate to join in the tribute to be paid to his memory.

But sometimes one can hardly help wishing that it were possible to pay a similar tribute to some of the old engineers of India who also showed great engineering talent. They would have been called *mistaris*, but what of that. Most of the fathers of engineering in England might be said to have come of the *mistari* class, they were certainly not of aristocratic descent; and the *mistaris* were the engineers of India, they engineered the ancient rock-cut temples, the temples and mosques in the open, the tombs, the great tanks, and other works, monuments of their skill. The works may be associated with the names of kings or princes, but the names of the men who constructed them have been long since forgotten. They were a humble people, working to orders and for a livelihood, though being human it is more than likely that they took some pride in the creative output of their hands. In the scheme of life of an older India they may not have been of much account, but among them were men of great ability, and we can only in an impersonal way take our hats off to them for what they did.

Indian Engineering.

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Notes and Comments.

Rebuilding Baghdad.—The Baghdad Corporation is busily engaged in considering the proposal of constructing a new city in the suburbs of Baghdad. The Commissioner of the Metropolis, in an interview with a representative of the Press, deposed that the construction work was to be entrusted to a suitable foreign company in case moderate terms cannot be settled with any of the Iraq companies.

Concrete Pipe Contract for Southampton Docks.—Contracts have just been let for over two miles of concrete pipe to be used in connection with the Southampton Docks Extension scheme. These 7 feet diameter pipes will be embedded in concrete culverts and laid under the tidal mudlands. Apart from the materials required in the pipes themselves, the culverts will call for some 50,000 tons of gravel and 7,000 tons of cement. Work is to commence immediately and will take about eighteen months to complete.

Jumna River Survey.—Mr. Addam-Williams, Chief Engineer to the Government of Bengal, Irrigation Department, visited Serajganj on the 28th instant, to make a survey of the Jumna river. In the afternoon, the members of the Town Protection Committee met the Chief Engineer, the Superintending Engineer and the Subdivisional Officer of the Irrigation Department at a conference at which a discussion was held about the ways and means to be adopted for the protection of the town. Immediate action is to be taken.

Fine Arts Exhibition.—Under the auspices of the Faculty of Arts, Bangalore, the fifth All-India Fine Arts Exhibition will be held in that city about the last week of June. The Dewan of Mysore is the President, and the sections comprise Western Art (paintings, drawings, portraiture, caricature, etc.); etchings, woodcuts, pastels, etc.; miniatures and sculptures; applied arts, wood, ivory and metal carvings; architecture and town-planning; photographic art; decorative arts; theatrical arts, and poster designs.

Eastern Bengal Railway.—At the 41st meeting of the Local Advisory Committee of this Railway held in Calcutta, with Mr. N. Pearce, the Agent, presiding, the question of the provision of an office for the Passenger Superintendent near the third class booking office at Sealdah was discussed and it was agreed that in the interests of the third class passengers generally, it was advisable to have the Passenger Superintendent's office located in the third class waiting hall. Several other proposals were put forward, amongst them the Sainthia-Berhampur-Bhairamara Railway project was tabled for discussion. The President, however, stated that the matter was still under consideration, and he was not in a position to discuss the project in detail until he had an opportunity of consulting the Local Government. The matter would, however, be expedited.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the period 9th to 14th March 1928:—Messrs. John Fowler and Co. (India), Ltd., Bombay—1 Road Roller, 10-ton, compound cylinder, Colonial type, complete with fittings, tools and spares, Rs. 8,800 free delivery at Lyallpur railway station erected, *ex* stock; 2 Tar Boilers, vertical type, portable, 50 gallons capacity, Rs. 1,000 free delivery at Ahmednagar; Messrs. P. Orr and Sons, Ltd., Madras—7 Levels, 14 inches, reversible, Rs. 3,308 free delivery at Rahim Yar Khan railway station; Messrs. Martin and Co., Calcutta—263 cwts. 19 lb. Beams, R. S., 10 inches by 4½ inches, British, Rs. 2,105 f. o. r. Howrah; Messrs. Jessop and Co., Ltd., Calcutta—158 cwts. 54 lb. Beams, R. S., 10 inches by 4½ inches, British, Rs. 1,307 f. o. r. Howrah; 150 cwts. Rods, M. S., ⅜ inch diameter, British, Rs. 2,063 free delivery Mubarikpur.

Forests and Irrigation.—In the United Provinces Council on the 28th instant, the Nawab of Chattari, Home Member, presented a demand for Rs. 27,51,087 under "Forests." Mr. Pant moved a token reduction to protest against the conversion of the turpentine and rosin factory at Bareilly into a limited company, on the ground that the concern, which earned annual profits of about Rs. 5 lakhs, was given away at a nominal price along with valuable concessions. The Home Member pointed out that the transfer took place in 1923, before he came into office, but that whatever had been done, had been done honestly and in the best interests of the taxpayers. The motion was adopted. The demand for Rs. 29,40,394 under the head "Irrigation Works" charged to revenue was put and voted. Twenty substantive reduction motions were discussed, one for Rs. 4,000 was accepted by the Home Member, five were rejected and several withdrawn. The House divided on four motions. The Government won every time with a large majority.

Railway Sleepers.—The Administration Report of the Forest Department of the Madras Presidency for the year ended 31st March 1927, states that the Valparai Sleeper Project which was sanctioned last year for the extraction of railway sleepers from the forests in the Anamalais, destined for planting with cinchona, has proved profitable. About 7,500 broad, narrow and metre-gauge sleepers were extracted. The result of the year's operations, including the value of the stock of sleepers not paid for at the close of the year, and the sale proceeds of scrap ends, was a profit of Rs. 19,795, after allowing for charges on account of road work, sawyer's sheds, etc. The work is now being continued on an extended scale. In accordance with the arrangements made between the Southern Group Sleepers Pool and the Madras Forest Department a total of 17,735 broad-gauge sleepers and 13,823 metre-gauge sleepers were supplied during the year. In addition, a contract was obtained for the supply of 15,000 narrow-gauge sleepers for the Cauvery-Mettur Project, 14,685 of which were supplied in the year.

Sind Feeder Railway.—Several objections were put forward against the proposed Sind Feeder Railway being constructed, in a discussion in Council on a resolution put forward by the Revenue Member, recommending acceptance of the guarantee required by the Railway Board against loss in working the proposed left bank feeder. The guarantee required is 4 lakhs a year for 5 years after opening and thereafter the actual loss in working subject to a maximum of 2 lakhs a year, these amounts being repaid to the Bombay Government with interest, should the line subsequently prove remunerative. The line will run parallel to the North-Western Railway for 130 miles, at no point further than 15 miles away. The cost of the proposed line of 162 miles is estimated to be Rs. 98 lakhs and its success will depend on that of

the Sukkur Barrage scheme, which is problematical. Another objection advanced was that the time had come when the administration of railway construction should be a charge on local boards, and not on the railway. Lastly, in view of the possibility of the separation of Sind no more commitments should be entered into by the Bombay Government. The Revenue Member argued that the Sukkur project would have the effect of greatly enhancing the value of unoccupied land served by the railway; an important consideration. The resolution was passed.

Bengal Agricultural Development.—Mr. Siddeseswar Mallik, discussing the possibilities of the agricultural improvement of Bengal at the Bengal National Chamber of Commerce on the 23rd instant, said that a vast field was waiting for all to work, which, if developed, would make Bengal one of the richest countries in the world. The very existence of the people of this country still depended on agriculture, and every one, zemindar, capitalist, merchant, industrialist or scientist, should all join and devise means to develop agriculture to its utmost extent. In Bengal they had 49,123,393 acres of cultivable land of which only 28,303,800 acres were under cultivation, so that a little less than half of the cultivable land of the province was lying fallow. Of this about 10 or 12 million acres of land could be immediately cultivated. If these lands were put to cultivation and profitable crops were grown it would add to Bengal's wealth by about 60 to 70 crores of rupees yearly. Modern, up-to-date and scientific methods must be employed and the primary necessity was the development of irrigation. Next to canal irrigation they should have water from tanks and wells, and he appealed to all public bodies to look to the re-excavation of all the old tanks of the province. The growing of paddy should be given the foremost place in their programme of agricultural development.

Twice Sunk during the War.—A good deal has been heard recently about the pioneer motor cars which were the first to run on the open road. A well-known daily paper organised a special run of these "Old Crocks" to celebrate the emancipation of the motorist from the burdensome restrictions from which he then suffered, such, for instance, as the legal obligation to have a red flag carried before him by hand. It was a wonderful sight to see these old machines trundling along, but one wonders how many could lay claim to equal the record which has recently come to light of one of the early motor boat engines. This engine is a single-cylinder unit, of 4 h.-p., and was built 20 years ago by the well-known marine motor manufacturers, the Ailsa Craig Motor Co., Ltd., of Chiswick, whose modern overhead valve engines are a bye-word with users for their fine qualities. The present owner of this little 4 h.-p. engine has had it in a 15 feet boat since 1910, when it came, already second-hand, into his possession. The only part worthy of note that he has had to replace is the magneto. In spite of the fact that it has been subjected to long periods of hard work, particularly during the war, and in spite of the fact that it has been twice sunk, it is to-day as good as new and runs without a hitch in all weathers. This is a fine record of which the owner is justly proud. Little wonder, therefore, that his new boat now being built is to be equipped with a motor of the same reliable make.

The Howrah Bridge.—It is expected that the repairs to this bridge will be completed towards the end of April. The principal part of the work has been finished, the only thing remaining to be done is the removal of one old girder on the northern side of the Calcutta end of the bridge, and the construction of a new footpath at that place. The total estimated cost of the work is Rs. 4,31,383. Replacement of the old shore spans each 160 feet long by new ones, forms the principal feature of the work. Under the design adopted the roadway and footpaths are carried on two girders, whereas previously these were carried on three girders, one of them being in the centre of the roadway. The work was so designed that the new spans might be introduced with the least inconvenience to traffic and such obstruction as had been caused is due to increased 'bus traffic into and out of Howrah Station. The new arrangement will provide more facilities to vehicular traffic, as, although the gross width of the roadway on the old spans was 44 feet, it was divided in the centre, and consequently allowed only two lines of traffic each way. The new spans on the other hand give a clear roadway of 40 feet and 6 inches and allow for five lines of traffic, and thereby provide more flexibility in the passage of vehicles. With the renewal of the shore spans, it is expected that the bridge will be serviceable for some 20 or 30 years more, but the construction of the new bridge is necessary.

Products of A Well-known Firm.—A name well known in the overseas markets in connection with oil and petrol engines for a variety of purposes is that of Petters, Ltd., whose works are at Yeovil and Ipswich. At the former the Westland Works are devoted to the manufacture of engines up to 36 b. h.-p. In 1918 it was found necessary to divide the works on account of the demand for Petter engines, and the manufacture of the larger sizes, from 25 to 500 b. h.-p., was removed to the works of Vickers-Petters, Ltd., at Ipswich. This business has recently been acquired outright by Petters, Ltd., and engines up to 600 h.-p. are now produced there. At the recent British Industries Fair at Birmingham a comprehensive range of engines and electric generating sets were shown, all of which were of particular interest to overseas visitors. Thus, for instance, the 18-21 b. h.-p. Petter oil engine, "S" type—a single-cylinder unit, operating on the two-stroke cycle as perfected by the firm and designed to run on a wide range of fuel oils, crude, residual or refined petroleum, gas oil, distillates and vegetable oils. Starting is instantaneous at any time without pre-heating by means of the patent cold starter, a simple but thoroughly efficient device, which provides sufficient heat for the ignition of the first few explosive charges in the cylinder, after which the heat of the combustion chamber is sufficient to continue ignition. The cold starter therefore places the Petter "S" type engine practically on a par with petrol (gasoline) engines for ease of starting. The device won the silver medal of the Royal Agricultural Society in 1923. The Petter design is notable for its extreme simplicity. Inlet and exhaust valves and valve-operating mechanism are non-existent and the number of working parts are therefore very small. Maintenance is therefore reduced to a minimum.

London's Latest Railway.—A new railway has just been put into commission in London. This is the Post Office Tube, which has been designed for accelerating the conveyance of letters and parcels through the City, and which will undoubtedly contribute to the reduction of surface street traffic. It runs from Whitechapel in the East to Paddington in the West, a distance of 6½ miles, connecting the General Post Office at Mount Pleasant with the principal district offices and railway stations in London. The railway possesses many novel features, and the method of automatically operating the trains is probably unique. The trains, consisting of one, two or three steel wagons, each capable of carrying a load of 1,120 lb., carry no driver or guard, the whole operation of starting and stopping being effected from switch cabins at each station. The tunnel is from 50 to 90 feet below the surface, and each station is provided with spiral shoots for downward mails and lifts for upward mails, while the principal stations are also equipped with electrically operated conveyor bands beneath the platform in which there are apertures every few yards. Mail bags unloaded from a train are dropped through these apertures and are carried by the conveyors to the lifts, which in turn carry the bags up to the sorting rooms, thus reducing man-handling to a minimum. As it is important that the air from the stations should not escape into the Post Offices, a ventilating system has been provided whereby a continuous down draught is maintained. Twenty-five electrically driven Sirocco fans, furnished by Davidson and Co., Ltd., of Belfast, draw the air down the lift shafts, distribute it by means of ducts throughout the station, and finally discharge the exhaust air through a duct carried up one of the vertical shafts and terminating in a cowl above the roof of the building over the station. The relief that this railway will afford to street traffic will be appreciated, when it is borne in mind that over 750 tons of postal business has to be dealt with daily, and that this railway will be capable of doing approximately 800 train journeys a day at an average speed of 20 miles per hour as compared with five to seven miles per hour by road.

Poor Man's Car in 1928.—"John Prioleau," who writes such instructive articles on the subject of cars in the "Evening Standard," has now discoursed on what he calls the poor man's car of the current year; and by that he does not mean the lowest-priced car but a low-priced car, a little more expensive than those sold at the lowest figures, because he evidently thinks that the extra money adds a good deal to the pleasures of ownership. He takes a maximum price of £250, and for this he says a man can buy a car of which he can be proud and which three years ago would have cost £350. He says that for between £200 and £250 a very nice car can be purchased, nice in equipment, qualities and performance, and without most of the drawbacks of the cheap cars of the past. The 9, 10 and 11 h.-p. engines of to-day are not only capable of sustaining high speeds for a long time without fatigue, but there is a pleasant measure of "hanging on," connoting decent acceleration and absence of that quick falling off in power against the collar which everyone dreads. The body-work has also been much improved, and it is now of a type which only a few years ago would have been found on none but expensive chassis of considerable size. The cars can be two-seater, four-seater, coupé or saloon, and for £200, £210, £220 and £250 there is a great variety on the market. Mr. Prioleau says that he has driven a 9 h.-p. car, weighing very little, at 50 miles an hour, with no more than a pleasant hum from its excellently balanced engine and with not a sound from the body-work and chassis. Such an opinion from an expert is good news for the poor man, but it is now tolerably well known that British car-manufacturers have accomplished wonders in the last few years. British workmanship is the best in the world, and British cars last longer, need fewer repairs, and have superior economy in consumption of fuel than the cars of foreign make. The Olympia Exhibition of November 1927 was notable among other things for the extraordinarily good quality of the low-priced cars exhibited. If they were cheap in price, they did not look cheap, and in their performances they were as good as they looked. With that recommendation, no object is served by purchasing vehicles from foreign countries.

The Institution of Electrical Engineers.—One of the signs of the great expansion of electrical engineering is the rapid increase of the membership of the Institution of Electrical Engineers. The Institution was founded on the 17th May 1871, as the Society of Telegraph Engineers. "The Times Trade and Engineering Supplement" gives the membership of the Society at the end of the first year of its existence as 110, and now there are over 12,600 members. The Supplement says that the growth of the Society and of the science with which it dealt was foreseen at the very outset, as shown by the remarks in a speech made at the opening meeting:—"This Society, I assume, will gradually, by natural selection, develop more into an electrical society than into a society of telegraphy proper; and the moment it is understood that all papers on electricity or bearing directly upon the development of electrical science are admitted, it at once takes the science out of the narrow groove into which it seemed to be drifting into the most extensive of all grooves, because it will be found ultimately to embrace every operation in nature." The speaker was truly prophetic in this utterance. The Society of Telegraph Engineers was founded a good many years after the first electric telegraph was erected and worked, but in the early seventies of the past century the advancement of telegraphy was very important, and it took some farsightedness at that time to realise the extent to which electrical engineering would ultimately expand. The Society grew into an Institution with a Royal Charter, and it is certainly not a body which deals with telegraphy only. It promotes the general advancement of electrical science and electrical engineering in all their ramifications, it facilitates the exchange of information by means of meetings, exhibitions, publications, the establishment of libraries, and the giving of financial assistance to inventors. Electrical engineering has made so rapid an advance in the last half century that it might be considered to be at a very high stage of knowledge, but as a matter of fact it is still in its infancy, and its potentialities are so enormous that the Institution is likely to be the most important of all the bodies dealing with the several branches of engineering.

Current News.

LIEUTENANT-COLONEL R. N. BURN is appointed to officiate as Chief Engineer, North-Western Railway.

MR. R. L. WALKER, I. C. S., has been appointed Officer on Special Duty with the Tariff Board, to act as Secretary.

THE Port of London authorities announce a very substantial reduction in the rates of exports shipped from their quays from 1st May.

THE Tharrawaddy Independent Irrigation Subdivision, P. W. D., Burma, Irrigation Branch, was constituted on 24th February 1928.

COLONEL CARTWRIGHT REID, C. B., Chief Engineer of the Vizagapatam Harbour Construction, is proceeding to England on leave prior to retirement.

THE Swansea Water Committee has decided to amend its specifications for water mains so as to include steel pipe, and thus give local firms an opportunity of tendering for their supply.

THE total approximate gross earnings of State railways up to 10th March amounted to Rs. 97,02 crores, or Rs. 445 lakhs more than the figures for the corresponding period of the previous year.

MR. G. ST. G. HIGGINSON, Statistical Officer, Bengal-Nagpur Railway, having proceeded on combined leave, Mr. S. N. Gupta, District Traffic Superintendent, is appointed acting Statistical Officer.

ARRANGEMENTS have been made by the Agricultural Department of the No. 4 Chungshan University, China, for the manufacture of modern agricultural implements in competition with imported goods.

THE total approximate gross earnings of State railways for the week ending 10th March amounted to Rs. 212 lakhs, Rs. 18 lakhs less than the figures for the corresponding week of the previous year.

THE "Modern Transport" states that the Indian Stores Department has placed a contract for nine shunting locomotives, each fitted with six-wheeled tenders, with Messrs. Beyer and Peacock, of Manchester.

RAI BAHADUR LALA NAND KESHORE, I. S. E., on return from leave, is appointed to officiate as Superintending Engineer, 2nd Circle, Irrigation Works, P. W. D., United Provinces, *vice* Mr. A. T. Braybrook, granted leave.

WHILE exploring the forests of Siam, an American traveller discovered an ancient city buried deep in the jungles of Siam. The city lies 175 miles away from Angkor and is believed to have held a population of a million souls.

THE Government of Burma (Ministry of Forests) have sanctioned the constitution of two temporary subdivisions to be designated "No. I and No. II Subdivisions," respectively, in the Rangoon University Division with headquarters at Rangoon.

THE services of Lieutenant-Commander S. B. Trenoweth, Engineer and Harbour Master, Port Blair, have been replaced at the disposal of the Marine Department, and Engineer Lieutenant-Commander G. L. Annett has been appointed in his place.

THE Government of India have sanctioned the construction, at the cost of the Dholpur Durbar, of an extension of the Mohari-Barauli Branch of the Dholpur Bari Railway on the 2 feet 6-inch gauge, from Barauli to Sirmuttra, a distance of 3·63 miles.

THE Railway Board have sanctioned a reconnaissance survey being carried out by the agency of the Bengal Dooars Railway Administration for a line of railway from Bagrakote to Sivoke, a distance of about 7 miles. The survey will be known as the Bagrakote-Sivoke Railway Survey.

MR. N. PEARCE, Agent of the Eastern Bengal Railway, has been unanimously elected President of the Indian Railway Conference Association for the year 1928-29 in succession to Sir Ashley Biggs, Agent, Madras and Southern Mahratta Railway, who has proceeded on leave.

THE Government of Burma (Ministry of Forests) have sanctioned the conversion of the Brickfields Division into a subdivision to be designated the "Brickfields Subdivision," with headquarters at Mingaladon, under the control of the Superintendent of Stores, Public Works Department.

THE aggregate tonnage of vessels launched on the Clyde during January and February constitutes a record for the first two months of the year, the total being 117,762 tons, compared with 93,400 tons in 1921, which was the previous record. For January and February last year the aggregate was only 13,350 tons.

WORK in connection with the laying of high tension cables in Hooghly and Chinsurah for the supply of electric current to Chandernagore from the power house of the Gourepore Jute Mill on the other side of the river has been started, and extensive digging operations are being made in the two towns. Two sub-stations for transmitting current have been constructed.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

DEVELOPMENT OF INDIAN ROADS.

SIR,—It appears from the evidence of Mr. G. G. Dey, Secretary to the Government of Bengal in the Public Works Department, before the Roads Committee at New Delhi on 18th January 1928, that both the Government of Bengal and the P. W. D. Secretary are of opinion that the construction of bridges and of roads should be financed by means of loans and that the distribution of funds to the provinces for the purpose of road development should be the basis of petrol consumption. It is much to be regretted that the Bengal Government and the P. W. D. Secretary have not taken into account the very severe risks which are involved in financing the construction of roads by means of loans; for even with limitations as to load and speed which are very difficult to enforce, unless a very accurate census of traffic is obtained and effect of different classes of traffic on road is very accurately known, a scheme may prove :—

(1) Either inefficient—that is, not sufficiently strong to stand the traffic, in which case the life of the road will fall short of the period over which the instalments and interests including sinking funds on the outstanding balances of the capital expenditure will remain undischarged ; or

(2) Too efficient or extravagant—that is, built with costly and durable material but the traffic does not develop as anticipated, in which case money would be locked up to meet the annual outstanding instalments to cover the cost over a long period when it would be urgently needed for other works.

When the life of a newly-constructed road is underestimated and the traffic develops beyond anticipation and it becomes necessary to meet maintenance charges far above the amount expected and further re-construction works have to be faced during the time when the instalments of the balance on the capital cost of first construction schemes are still to be cleared off.

This is a contingency which should be guarded against as it not only puts a tax on the rate-payer of to-day for debts incurred which should have been paid by his predecessor who got the benefit of the road, but it places a mortgage on the sums to be raised by the rate-payers of to-morrow, which is against the principles of State economics.

Bridges, of course, stand on a different footing and their construction may be financed by means of loans, if required.

As regards distribution of funds, the first essential requirement for the development of motor transport being the construction of a system of good roads and their maintenance in an efficient order, the basis of distribution should be the expenditure required for the purpose. If the consumption of petrol be taken as the basis, then those areas in which the consumption is low will get small grants, leaving the roads in an undeveloped state, and transport will suffer. The only advantage which the principle of distribution according to consumption of petrol seem to possess is the encouragement it gives for the use of petrol ; but I am afraid that the advantage cannot be obtained unless the road system is developed first.

G. C. BANERJI,
Late Executive Engineer, P. W. D., Bengal,
ALIPUR, *26th March 1928.* *Consulting Engineer.*

Literary Notices.

The Electronic Theory of Valency.—By Nevil Vincent Sidgwick, M. A. (Oxon.), Sc. D. (Tubingen), D. Sc. (Leeds), F. R. S., Fellow of Lincoln College and University Reader in Chemistry, Oxford. Oxford, at the Clarendon Press. 1927. Price 15*s*.

This is essentially a technical work, but of great value to chemists and physicists. The author in his preface writes :—This book aims at giving a general account of the principles of valency and molecular constitution, founded on the Rutherford-Bohr atom. In developing the theory of valency there are two courses open to the chemist. He may use symbols with no definite physical connotation to express the reactivity of the atoms in a molecule, and may leave it to the subsequent process of science to discover what realities these symbols represent ; or he may adopt the concepts of atomic physics—electrons, nuclei and orbits—and try to explain the chemical facts in terms of these. But if he takes the latter course, as is done in this book, he must accept the physical conclusions in full, and must not assign to these entities properties which the physicists have found them not to possess, he must not use the terminology of physics unless he is prepared to recognise its laws. I have endeavoured to conform to this principle, and not to lay myself open to the reproach of an eminent physicist, that "when chemists talk about electrons they use a different language from physicists." I have been careful to avoid as far as possible the introduction of any physical hypotheses which are not already sanctioned by those who are best qualified to judge of them. Chemists and physicists will peruse the volume with profit.

FOR SALE.

ONE MARSHALL'S STATIONARY LOCOMOTIVE—MULTITUBULAR BOILER, 35 N. H. P.; working pressure 150 lbs. per square inch; tested by hydraulic pressure to 275 lbs.

2. ONE NEW STEAM DRIVEN AIR COMPRESSOR complete with R.A-39, unloader A-56, steam regulator and fly wheel governor, foundation bolts, and full set of wrenches; piston displacement 173 c.ft. per minute; steam pressure 80 to 120 lbs.; air pressure 65 lbs. to 100 lbs.

3. ONE MARSHALL'S CROSS TUBE VERTICAL BOILER OF 12 N. H. P. complete with injector only; working pressure 100 lbs.; hydraulic test 200 lbs.

R. L. MITTER,
EXECUTIVE ENGINEER,
P. W. D., B. & R. Branch, Provincial Division,
Jhansi.

Foreign Notes.

The Inductaphone.—New methods of wrapping cables, which make it possible to hear sounds from under water by induction, were demonstrated at Chicago by Mr. Charles R. Withers, an electrician. The inventor said the Navy Department had agreed to test the device, which is called the Inductaphone. At a demonstration of the invention for the United States Coast Guard, Mr. Withers submerged a cable to which were attached automatic sending and receiving sets; another cable, dragged through the water over the submerged one, picked up messages from the set by induction.

Manitoba Electric Scheme.—The Manitoba Government has decided to appoint a Provincial Hydro-electric Commission, to take charge of and develop its electric distribution scheme. In preparing the necessary legislation, the Manitoba Government is availing itself of Ontario's successful example, and information is now being sought from the Ontario Commission as to the working of the system. It is also seeking to obtain temporarily the services of some of the officials of the Ontario system, not only to assist in the work of organisation, but in the investigation of the water power resources of the Province which will shortly be undertaken.

German Plant for Russia.—The Soviet Government has placed orders in Germany for the construction of equipment for two works for the production of concrete parts necessary in connection with the building of the Dniepr hydro-electric station. The orders were placed with Krupps, who are to supply all the necessary machinery, except the electric motors and other electrical appliances. In view of the credit facilities which are at present accorded by Austria for Soviet orders, a number of orders for the Dniepr station will be placed in Vienna. The foundation stone of the station was laid in November and it is said that the station will be the largest in Europe.

Power Possibilities of the English River.—Engineering surveys have indicated that two-fifths of the power possibilities of the English River, Canada, or some 212,000 horse-power, lie in Ontario, while the balance lies in Manitoba. The construction of a dam at Ear Falls on Lac Seul is essential to the securing of power for Ontario and to the securing of further power for Manitoba, where there are already power developments on the Winnipeg River which would be benefited by the regulation of the flow of the English River. The proposed dam will raise the head of Lac Seul some 11 feet or 12 feet. It is estimated that its cost will be in the neighbourhood of 500,000 dollars.

Large British Contract.—"The Engineer" learns that a contract of a value exceeding £800,000 has been awarded by Imperial Chemical Industries, Ltd., through its associates, Synthetic Ammonia and Nitrate, Ltd., to International Combustion, Ltd., of Kingsway, London, for an extension of the pulverised fuel plant at the electricity works on the north bank of the Tees at Billingham, between Stockton and West Hartlepool. This station will rank as the largest electrical generating plant owned by any individual industrial firm in Great Britain. No less than 20,000 tons of iron and steel structural work is required, and the order for its manufacture and erection has been placed with Dorman Long and Co., Ltd., of Middlesbrough.

The Water Power of the World.—According to estimates made by the Geological Survey of the United States Department of the Interior, the developed water power of the world was about 33,000,000 h.-p. at the end of 1926, compared with 23,000,000 h.-p. in 1920, and 29,000,000 h.-p. in 1923. About three-quarters of the increase in the last three years has taken place in the English-speaking section of North America. The potential water power of the world is estimated at 454,000,000 h.-p., of which 190,000,000 h.-p. is in Africa. Only 14,000 h.-p. of this has, however, yet been developed. The water powers of South America and Oceania are also largely untouched, but of the 58,000,000 h.-p. in Europe, 13,100,000 h.-p. has been developed, the corresponding figures for North America being 66,000,000 h.-p. and 16,800,000 h.-p.

Launch of the S. S. "Ceylon Bul-Bul."—The first vessel to be built for the new company formed to carry out deep-sea fishing in Ceylon waters, and known as the Ceylon Fisheries, Limited, of Colombo, Ceylon, was successfully launched on 8th February by Messrs. Cochrane and Sons, Limited, Ouse Shipbuilding Yard, Selby. The vessel, which has been named the "Ceylon Bul-Bul," is a steel screw trawler of the following dimensions: length, 125 feet; breadth, 23 feet 6 inches; and depth 12 feet 6 inches. An insulated and refrigerated fish hold is provided, with a CO_2 refrigeration plant supplied by Messrs. J. and E. Hall, Limited, of Dartford. The propelling machinery, which is being constructed by Messrs. C. D. Holmes and Company, Limited, of Hull, will consist of a set of triple-expansion engines having cylinders 12½-inch, 21½-inch and 35-inch in diameter, and a stroke of 24-inch, working at a normal pressure of 180 lb.

Barrage Construction in North Africa.—The collapse of the Perregaux barrage in North Africa a few months ago, when it gave way to the pressure of an unusual weight of water during a flood and caused widespread disaster, was made the subject of a communication to the Academie des Sciences by M. Mesnager, the well-known authority on hydraulic constructions, who declared that solid barrages in France were too often designed with a wholly insufficient margin of safety, and constituted a perpetual danger. The trouble arose, he said, from an erroneous interpretation of the Maurice Lévy formula. The thickness at the base should be multiplied by 1·4, and that entailed a considerable addition to the cost. The danger to the public, declared M. Mesnager, was so great that a remedy must be found, and he suggested the suppression of solid barrages in favour of vaulted structures. These statements are strongly criticised by the Comite Francais des Grands Barrages, which remarks that, some years ago, a Government circular abolished the use of the Maurice Lévy formula, and that the thickness at the base of solid barrages has even been reduced, without there having been a single instance of a barrage in France giving way to flood preasure. The construction of solid barrage is based, the Committee explains, upon experience in this and other countries, and it affirms that, if the thickness at the base had to be increased to the extent suggested by M. Mesnager, construction would be financially impossible.

Linking up the Sudan Railways.—According to the "Railway Gazette" a message from Khartoum reports that it has been decided to proceed immediately with the construction of the projected extension of the Kassala-Gedaref line to Makwar and so link up with the main line of the Sudan system. Ever since the extension from the Red Sea line to Kassala, 217 miles, was completed, it has been apparent that the best results could not be secured until this line, which then terminated close to the Eritrean frontier, had been extended to join up with the main stem, so, first, the Gedaref line, 135 miles, was put in hand, and now the final section of 145 miles is to be built. The line will open up an extensive area capable of producing cotton, grain, etc., and will doubtless be the means of stimulating development to the south and east of the route. Makwar is 171 miles from Khartoum, and is the location of the great Sennar Dam, 1⅝ miles long, by means of which the Gezira plain is irrigated. When completed the new line will provide a most useful alternative route between the south and Port Sudan, and afford much-needed relief to the existing main line in handling the heavy traffic offering during the busy periods of the year. When the new line is open for traffic the Sudan Railways will comprise about 2,000 miles of 3 feet 6-inch gauge line, supplemented by steamer services operating over 2,500 miles of river.

Diesel/Steam Locomotives.—According to the "Railway Gazette," Mr. R. Hildebrand, in a recent paper before a meeting of the American Society of Mechanical Engineers, gave some interesting particulars relating to a Diesel/steam locomotive which he has planned and which differs in some important respects from the Still locomotive developed in this country. The Hildebrand, or as it is called, the D-H locomotive, as distinct from the Still, develops Diesel power (high efficiency) and steam power (high overload carrying capacity) at both sides of the piston, and it is claimed that as a consequence of this a D-H locomotive with the same cylinder volume as the Still will have about twice the starting and overload carrying capacity. When the engine runs at normal speed with an average load Diesel power only will move the train, and the locomotive whilst thus working will operate with a thermal efficiency in the neighbourhood of 33 per cent. and a mechanical efficiency of about 84 per cent. As the axles are directly driven and the engine will be of the double-acting 2-cycle type, when climbing steep gradients the engine will use Diesed plus steam power, and when steam is used in addition to Diesel power the steam will be admitted into the cylinders after the combustion of fuel is substantially completed and after the gases are expanded to a pressure which about equals that of the steam. The admission of steam into the power cylinders will start when the load begins to exceed the average, *i. e.*, when the normal Diesel rating of the engine is reached and overstepped. The steam will then carry the load above that which can be carried by Diesel power.

Fuel Oil Consumption in the United States.—According to statistics collected by the United States Bureau of Mines and the American Petroleum Institute, the consumption of fuel oil is concentrated in the seaboard States. The States bordering on the Atlantic and Pacific Oceans and on the Gulf of Mexico required, in 1926, four-fifths of the total fuel oil produced, which amounted to 340,481,000 barrels. Export represented about 10 per cent. of the total, and 85,000,000 barrels went into the bunkers of ocean-going vessels, including ships for army transport and navy vessels. Thus over 255,000,000 barrels, or 67·5 per cent., were left for commercial and industrial users. Among these, the railroads made the largest demands, namely, 74,700,000 barrels. Oil companies come next, consuming nearly 49,000,000 barrels, which was used as fuel in refineries or in the field. Gas and electric power plants utilised 33,000,000 barrels, and smelters, etc., 25,000,000. In commercial and domestic heating the consumption was 17,000,000 barrels. For the past eight years coal has been the chief fuel employed in electricity generation. The use of fuel oil in these works has decreased while the consumption of natural gas has increased. The demand for oil for domestic heating amounted to 8,800,000 barrels in 1926. With regard to shipping, it is noteworthy that 76 per cent. of the oil-burning steam craft are operated by British and American companies. The great consumption of fuel oil by the railroads is concentrated in the south-central and south-western States, where commercial cool deposits are far apart; 90 per cent. of all the oil consumed is fuel oil, not crude oil.

Roller Bearing Freight Car Tests.—Details of some convincing tests made in America with the object of determining what advantages are secured from the use of antifriction bearings in railway rolling-stock were given by Mr. Walter C. Sanders in the course of a paper read towards the end of last year at a meeting of the American Society of Mechanical Engineers, says the "Railway Gazette." The particular tests mentioned were made with two heavy freight cars, one equipped with roller and the other with plain bearings. The first of these weighed, together with its load, approximately 54 tons 8 cwt., and the other, *i.e.*, the one with the plain bearings, 54 tons 1 cwt. It was shown that the ratio of the starting resistance of the two cars was 8·8 to 1 in favour of the one with roller bearings, or a saving in tractive effort at starting of 88·8 per cent. In the acceleration test, each vehicle was in turn hauled by a 300 h.-p. plain bearing electric motor coach for a run of 20 seconds' duration, the readings being taken as soon as the cars started and for 5 seconds thereafter. The average of results showed an acceleration in miles per hour per second for 15 seconds to be 0·69 for the roller bearing and 0·57 for the plain bearing car. Speed after 20 seconds was 10·54 m. p. h. for the roller bearing and 8·75 m. p. h. for the plain bearing vehicle. The distance travelled in 20 seconds was 144·94 feet for the roller bearing and 122·23 feet for the plain bearing car. A running test was made to determine the actual saving in power consumption of the roller bearing vehicle. The test run was made over a stretch of track 28·30 miles long, which included varied conditions of gradient and permanent way, readings being taken every 15 seconds. The net results indicated a power saving of 17·4 per cent. in favour of the roller bearing car.

General Articles.

THE CORROSION PROBLEM.

LITTLE real progress has yet been made in the highly important field of anti-corrosion methods, and the annual loss throughout the world as regards iron and steel reaches a stupendous figure. Thus, the great Forth Bridge near Edinburgh is always being painted, since no sooner has one end been reached than it is time to begin again at the other, and in the fight against corrosion it would be interesting to know the cost in paint alone. The world is stated to be losing £500,000,000 per annum due to the corrosion of iron and steel, about one-third of the total production which seems an incredible figure, but it is probably an underestimate.

The serious character of this problem of corrosion is well illustrated by a valuable contribution at a recent Exhibition of Metallic Construction Material in Berlin, in which it is stated that between the years 1890-1925 40 per cent. of the total metal produced in the world has been lost by rust and corrosion. In Germany alone approximately £50,000,000 per annum is the bill for this reason alone, and the German State Railway Administration, for example, has to spend 48 million marks every year, that is about £2,500,000 in order to try and protect metal.

The matter has become much more serious of late years because of the increasing tendency to use cheap mild steel at every opportunity, and there seems to be no question that one of the main remedies is to return to a considerable extent to the use of wrought-iron, especially when the weight of the metal is not so great.

As to why good class wrought-iron should be non-corrosive is a mystery, like most other things in connection with corrosion, and it may be remembered that a description of the best genuine Yorkshire iron has already appeared in these columns. Messrs. Robert Heath and Low Moor, Ltd., have at their Low Moor Iron Works in Bradford a cross-section of a Yorkshire iron bar taken out of a wagon boiler after being in use for 100 years, all the more extraordinary because the water was of a very bad character, being 26 degrees total hardness and not softened or treated in any way. This bar is to-day still 85 per cent. of its original cross-sectional area, while an ordinary steel bar under the same conditions would have been more or less completely dissolved probably 50 or 60 years ago.

Altogether it is difficult to realise the magnitude of the problem of corrosion, which seems to become more baffling the more it is investigated, of which one striking illustration out of many similar ones that could be given, is that a piece of polished steel, for example, placed in water, will begin to corrode almost immediately under normal conditions, but if the velocity of the water flowing over it is in a very restricted range then corrosion ceases. This is due apparently to some mechanical action of the water on a film, perhaps oxide of iron developed on the surface of the steel, and apparently chemical, electrical and mechanical operations may all come into play.

THE RESTORATION OF THE ANCIENT IRRIGATION OF BENGAL.

BY SIR WILLIAM WILLCOCKS, K. C. M. G.

A lecture delivered at the British Indian Association Hall, Calcutta, on the 6th March 1928.

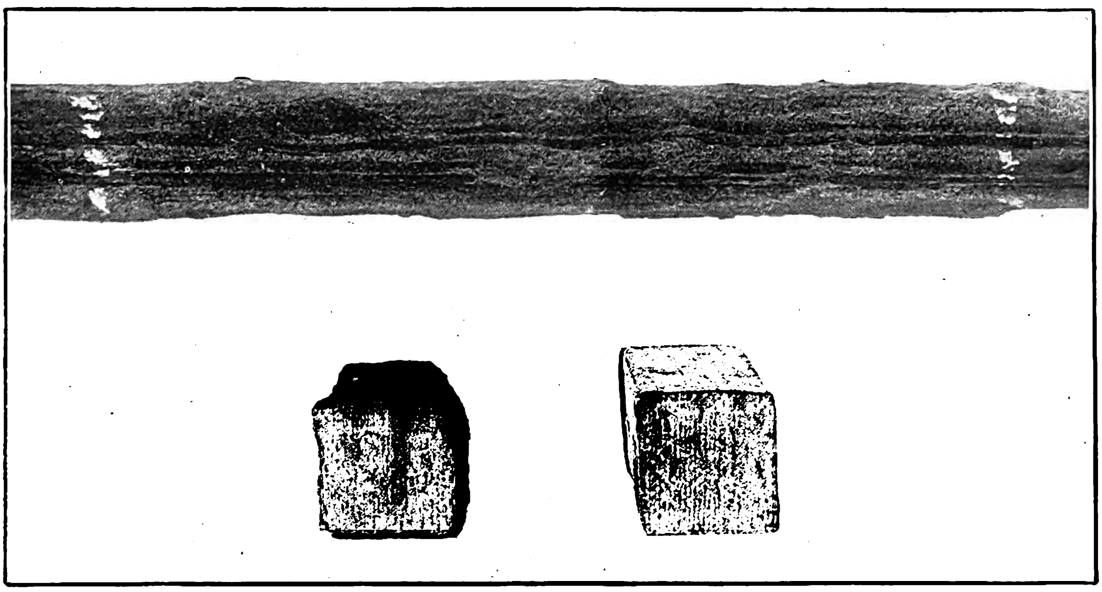
(Continued from page 168.)

17. We now come to the Bhagirathi river or the Hooghly. The Ganges at the head of this river has played havoc with it altogether. The Faracca head has gone. The Ganges and the Bhagirathi are one below Dhulian. Above the Kaleeganj head the river is devouring the land and has thrown up a bar up to the full height of the flood of 1927; and in September, during the height of the flood, they were using grass screens to get the flood to scour it away. They got the flood to enter on one side. The lower Bishwanpoor entrance shown on all the maps is silted up to the level of the land on a length of some 3 miles, the river enters where it likes and where it can, and as a rule it enters where it is eating away the bank, and the waters are laden with the silt torn down. At the Bishwanpoor head the river has set upon the old bank in fury and is eating away trees, houses and gardens. While we were standing on the bank, as a big stern wheeler passed, 5 feet width of bank nearly under our feet was opened up by cracks. The Bhagirathi above the Kaleeganj head may be given up. It is in the grip of the river. From Kaleeganj to Bishwanpoor the bank should be fixed where it is at the Kaleeganj opening and at the Bishwanpoor opening and trained above both openings and below them. Below Bishwanpoor the Ganges leaves the Bhagirathi for good. The Ganges bank at Bishwanpoor is solid and a valuable asset while valuable mango groves and rich lands and houses are crying for protection. It is the last head for the Bhagirathi. No money should be spared here. Get a river happy in its low weather channel and it will keep there in flood.

18. Until protective works fix the bank and training works keep the Ganges in a stable channel the Bhagirathi will continue to silt up and the Hooghly will become shallower and shallower. And if the Bhagirathi becomes smaller, the Bhairab-Jellingi will become a more important feeder of the Hooghly, and the whole of the silt scoured out by it as it increases its section will be carried into the Hooghly. The Calcutta Port Trust spend their time and money on the Hooghly. They would show wisdom if they spent some of both on the head of the Bhagirathi. The Ganges is out of hand and old landmarks are disappearing. If any of the Port Trust think I am overstating, I am prepared to go with them to the heads of the Bhagirathi. Once the Ganges is trained and the banks protected and the Nadia barrage built the Hooghly will become stable and there will be enough of water all the year round for perennial irrigation by pumps for scores of miles above and below Calcutta and for 20 miles inland. The dirty grubby slums and environs of the city will have had their place taken by such a landscape as we see around Cairo.

18A. The malaria along the Hooghly generally, and the Ganges in places, and in the immediate vicinity of Burdwan, and in places elsewhere is increased by the neglected undergrowth devoid of life, under the dense clumps of trees which are so much in evidence. The undergrowth in Eastern Bengal has not this unkempt appearance nor is it so devoid of life. Such dense clumps of trees with dense undergrowth under them harbour mosquitoes, and often very malignant mosquitoes. I think every effort should be made to clear out these mosquito dens. Small wood is of value in certain classes of engines, and once a decent supply of water comes down the Hooghly in winter and summer it will be possible to put up pumps and utilise this undergrowth and so diminish malaria.

Low Moor Iron Works Tar Macadam Plant for using cold blast slag.



Slightly Corroded Bar after being in use for 100 years. 85 per cent. of the original cross-section as shown by a new bar.

THE CORROSION PROBLEM.

And when land becomes valuable as it will, such undergrowth and the denseness of the trees will disappear and vegetables and fodder crops take their place. That will give the finishing touch to the disappearance of malaria.

19. We now come to Western Bengal, of which I said that a red water famine had overtaken it! Why has a red water famine overtaken Burdwan? Why has Burdwan, which was the health resort of Calcutta at one time, given its name to a very bad form of malaria? Its river, the Damodar, does not lie low like the Ganges, but could as easily irrigate the whole district as it did in the past. What has happened? Burdwan and Hooghly and Howrah (once part of Burdwan) have been deprived of the rich red water of the Damodar flood. Here is a description of this tract by Hamilton in 1815: "In productive agricultural value in proportion to its size, in the whole of Hindustan, Burdwan claims first rank and Tanjore second." This is very instructive. One can see by the lie of the canals (called to-day rivers) which take off from the Damodar that the same wise rulers who dug the canals in Central Bengal had dug those in Burdwan. And history tells us that men from Lower Bengal dug the canals at Tanjore. In all these three places the canals lie alike, parallel to the current without cross banks, interfering in no way with the thorough mingling on the rich red water of the river with the clear rain water. Burdwan was especially fortunate as the Damodar lay high and could easily irrigate. It had moreover 50,000 tanks which stored flood water for summer use and could irrigate some 150,000 acres of sugarcane.

20. It is evident that by 1815 the zemindars and tenants of Central Bengal had neglected the clearing of the canals and the repairing of the banks with the silt so cleared, a work known as "pulbandi" and which in Egypt the forced labour gangs had done for 7,000 years until the English freed the forced labour and did the work by contractors. This negligence must have begun in Bengal in the troublous Mahratta and Afghan wars, and the English who were traders and sailors never understood it. They thought the canals (called rivers) were only for navigation. This negligence made Central Bengal in 1815 cede the place of honour it held in 1660, to Burdwan whose river, the Damodar, was much better placed for irrigation than the Ganges. Decay had begun in Central Bengal and it began later in Burdwan where the canal clearances and bank repairs were neglected on the canals which took off from the river, and the embankments of the Damodar alone were maintained. As the uncleaned canals took less and less, more water remained in the Damodar and it became a menace to the country. The Damodar banks assumed an importance unknown before.

21. Pages 164 to 166 of the "Hooghly Gazetteer" are now very instructive reading. A committee in 1846 recommended that the banks of the Damodar be removed and "drainage channels" be substituted. This was their way of saying that "the canals be cleared." Nothing was done, and as the canals were not cleared the banks on the Damodar remained. They were frequently breached or cut for irrigation. When you read that 25 breaches took place in 1847, 14 in 1849, 56 in 1850, 45 in 1852, and 28 in 1854 you may be quite sure the banks were cut. So many breaches by their own accord were impossible in a single year for each breach eases the situation. The Government took over the embankment and thoroughly strengthened the left embankment behind which the E. I. Railway had sheltered itself and made a second bank. The grand trunk road which was always breached in old times was much raised and made a third bank, and later the Eden Canal made two more banks, or 5 banks in all, like 5 Satanic chains binding the Damodar and dooming the once healthy and prosperous tract between it and the Hooghly to malaria and comparative poverty. In 1859 the right embankment of the Damodar was removed for 20 miles as it sheltered no railways, and in May 1863 the Lieutenant-Governor recorded that the fertility of the area subject to inundation had been greatly improved. Lower down, the Damodar has risen and risen and is now 20 feet above the level of the country on the left bank; and, further down still, has breached its right bank and gone its own way, but the right bank is outside Burdwan. Along its left bank the river is in water-tight embankments.

22. I purposely give this Burdwan history fully as one can grasp on a small scale what it would take a volume to describe on a large scale in Central Bengal.

22A. Now see what happened to Burdwan and Hooghly which were deprived of their overflow irrigation. The District Gazetteer of Burdwan (page 41) says:—"Dr. French in his special report on the outbreak of epidemic fever estimated the total mortality at about one-third of the whole population between 1862 and 1872." Lieutenant-Colonel Campbell states of Hooghly "It would appear that, before the fever broke out, the Hooghly district must have had a population of something like 2,000,000 and that during the 20 years the fever lasted, the population fell by 50 per cent." If one wants to know what is going on to-day let him read Dr. Bentley's striking book "Malaria and Agriculture" (Bengal Secretariat Book Depôt. 1925. Price, Rs. 2-2 or 4 shillings). The situation from the point of view of health is bad enough, it is more desperate physically. I have seen places where the bed of the river is already above the country and the flood water 20 feet above the country, and rising every year. This is, as already stated, in the lower reaches. In the upper reaches where operations must begin, operations which will relieve the situation lower down, the height of the Damodar is excellent for remedial measures. Now is the time to do something.

23. How does nature succeed where men fail? Nature is "careless of the single life, careful of the type." One courts failure by being careful of the single life and careless of the type. If there is one thing one has learnt in Bengal it is that health and wealth have accompanied the "overflow irrigation" of the ancients, and malaria and poverty have followed its abandonment. Let this fact be graven on our minds, and success will be assured if we project our works on the spacious lines of the men of old. The overflow irrigation of Bengal is no hole and corner patchwork doomed to failure like the ridiculous Midnapur and Eden canals which lose money and play at irrigation, whatever else they may profess to do. It is not engineering, as I have learnt it, to design works which put second things first and first things second. *The first things in Bengal is to give plentifully of the rich red water of the flood and so enrich the soil and combat malaria.* The second thing is to supply October water which does neither of these. The first is for every year and every place. The second is only for the years in which the monsoon fails early. The first has unlimited supplies to draw on. The second draws on limited supplies. The first is a necessity. The second is a luxury. And the first has this great advantage that the crops irrigated with the rich red water of the flood have a vigour and stamina which enable them to withstand the early failure of the monsoon in a way the anæmic crops deprived of the rich red water of the flood have no knowledge of. Anæmic plants and anæmic men go together. No public funds should be spent on the second till all have been supplied with the first.

24. On the Damodar, the prior claims to public funds and to flood and October water are those of the proprietors of lands on the left bank of the Damodar, in Burdwan and Hooghly from near Burdwan southwards, who have had their flood and October supplies cut off by banks and who are in consequence

reduced to poverty and afflicted with malaria. The rich red water of the Damodar and the limited supply of October is their heritage. Now how does the *Damodar project* stand with respect to these well recognised claims? It proposes to give the luxury of irrigation with limited October water, taken off from above an expensive weir, to lands which have no claims whatsoever to it. It ignores the very special claims of those below, who could have both flood and October water without a weir. It is no answer to say that a subsequent prolongation of the Damodar canal will give October water to these lands. It could in this way only be given to a small fraction of them and then only by seriously hurting their drainage. The Damodar project cannot be, in any way, justified. It should only be carried out *after* all these lower lands have had their claims satisfied and then with surplus water. Knowing as I do the great responsibility one shoulders when one sets himself to repair past errors, I can only attribute the gross injustice of this proposed canal to the extraordinary timidity the Irrigation Department has shown these 40 years in undoing the evil done on the Damodar. I call upon the engineers to reject their own proposal and do an act of simple justice to a population whose number cannot be under a million.

(To be continued.)

THE PYRAMID KENNEDY FORMULA.

II.

THE table which follows (D) completes the analysis given in table A for the remaining "Kennedy" formulas, namely: Egypt, Madras, the Rio Negro, and Burma. The effect of the departure from the index (of d) $= 0·50$ is marked in both tables A and D, and is particularly well shown in the case of the Rio Negro ($V_o = 1·01\, d^{·44}$).

To illustrate what is meant, assume an imaginary formula: $V_o = 1·00\, d^{·50}$; $C_o = \sqrt{2}$.

d	$C_o = \sqrt{2}$			
	f_p	m_p	x	V_o
2	1·500	1·000	2·00	1·414
3	1·500	1·500	2·00	1·732
4	1·500	2·000	2·00	2·000
5	1·500	2·500	2·00	2·236
6	1·500	3·000	2·00	2·449
7	1·500	3·500	2·00	2·646
8	1·500	4·000	2·00	2·828

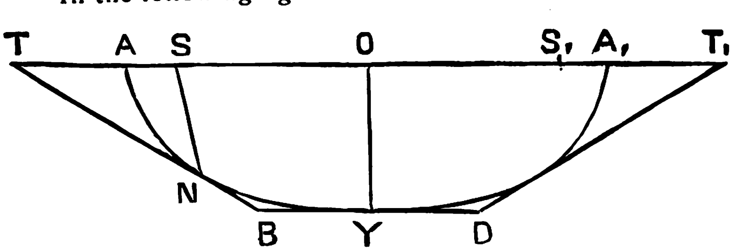
TABLE D.

d	$C_o = 0·6596$. $V_o = 0·3914\, d^{·737}$				$C_o = 0·8064$. $V_o = 0·67\, d^{·55}$			
	f_p	m_p	x	V_o	f_p	m_p	x	V_o
2	1·447	0·965	1·52	0·648	2·220	1·480	14·92	0·981
3	1·739	1·739	4·65	0·870	2·312	2·312	18·52	1·226
4	1·982	2·643	8·63	1·072	2·379	3·172	21·82	1·436
5	2·193	3·655	14·02	1·261	2·433	4·055	25·04	1·624
6	2·383	4·765	22·04	1·440	2·478	4·955	28·73	1·795
7	2·555	5·963	35·19	1·611	2·516	5·871	31·39	1·954
8	2·715	7·240	61·69	1·775	2·550	6·799	34·67	2·103

d	$C_o = 0·9861$. $V_o = 1·01\, d^{·44}$				$C_o = 1·234$. $V_o = 0·95\, d^{·57}$			
	f_p	m_p	x	V_o	f_p	m_p	x	V_o
2	2·896	1·931	189·92	1·370	1·960	1·306	8·20	1·410
3	2·759	2·759	75·14	1·638	2·075	2·075	10·70	1·777
4	2·665	3·553	50·69	1·859	2·160	2·880	13·00	2·094
5	2·595	4·324	39·85	2·051	2·228	3·714	15·20	2·378
6	2·538	5·077	33·90	2·222	2·286	4·572	17·44	2·638
7	2·492	5·814	29·34	2·378	2·336	5·450	19·63	2·880
8	2·452	6·539	26·32	2·522	2·380	6·346	21·87	3·108

By varying C_o other series of x appear.

In the following figure :—



Let $TBDT_1$ be a Pyramid 5 : 3 side-slope section, in which the factorized data are used: $BD = x$; $OY = 3$. In the trapezoid inscribe a semi-ellipse ANYA, touching the side-slopes, so that they will be, with the bed BD, all three straight lines, tangents to the ellipse. Then since OY is a constant 3, whatever value is assigned to x, $AS \times AS_1 = 9$, S and S_1 being the two foci of the ellipse. Call $AS = A_1S_1 = e$, and $OS = OS_1 = t$.

$$x = \frac{9}{e} - e + \frac{30}{\frac{9}{e} + e} - 5$$

When $e = 1$, $\frac{9}{e} - e = 8$ and $\frac{9}{e} + e = 10$; $x = 8 + 3 - 5 = 6$.

The writer has drawn up a table on the above figure for $x = 5$ to $x = 55$. In the first value, f_p is also the f of the inscribed ellipse, and AT throughout is nearly a constant in Y-units, varying from 2·60 to 3·02. Beginning the series of V_0 from $x = 5$, for f_p, the ratio rises from 1·000 to 1·234. The corresponding V_0 for the semi-elliptical sections, however, rise only in ratio to the largest section from 1·000 to 1·094.

The interested reader is recommended to draw complete graphs and diagrams modelled and extended on the tables given for such Kennedy Formula as he works with. It is impossible to do all this in INDIAN ENGINEERING.

It appears to be necessary to experiment at first for the local critical mean velocity with a good $x = 5$ section. In foot measure, see above figure, TT_1 would measure newly dug 15 feet, BD = 5 feet, and OY = 3 feet. The exact critical mean velocity of flow ought to silt this section $TBDT_1$ to the exact semi-ellipse $ANYA_1$.

The next step is to determine exact V_0 in precisely similar conditions to those obtaining in the experimental channel, which secure exact semi-elliptical sections.

The Kennedy section of observation which has $d = 5$, was credited with a bed-width of 61 feet, and V_0 (observed) 2·33. The b/d was 12 : 1 nearly, $x = 36$. Compare this with the corresponding entries in table B (art. I of P.K.F.). The P.K.F. V_0 vary by 21½ per cent. of the smallest; and Kennedy's V_0 (constant for all x) is more than 13 per cent. above the smallest.

By the Barnes' approximate formula, $v = 60\ m^{\cdot 7}\ i^{\cdot 5}$, assuming i constant, v varies as $m^{\cdot 7}$. In the above case, $m^{\cdot 7}$ varies as 1 : 1·312, and V_0 as 1 : 1·215. Therefore i cannot be a constant for a constant C_0, unless f_p is also a constant (see the "Factorization" articles).

It would be very interesting to know the sequence of v in any of the Kennedy sections which led to its formation and the final observed V_0.

A practical test calculation made with observations from Barnes' book may be useful. They are based on the equation :—

$$f_p = \frac{(3\ W - 5)}{W + 2}$$

TABLE K.

Ref. No.	Data.			Deduced.	
	v	W	y	f_p	C_0
3030	2·82	36·91	1·77	2·460	1·353
3031	2·79	38·12	1·70	2·477	1·360
3032	2·74	40·19	1·60	2·502	1·369
3033	2·71	41·74	1·53	2·520	1·378
3077	3·834	75·44	3·60	2·729	1·223
3113	1·459	286·1	12·33	2·927	0·243
3120	3·321	285·3	17·00	2·927	0·471

The first four are in the Solani Embankment, and are remarkably consistent. No. 3077 is a section in the Chenab Canal, and not far from the Kennedy value of $C_0 = 1·201$. The last two are the Irawadi River in Burma, the two sections having the same f_p to within 0·0002. The first five observations may be (the writer does not say positively that they are) instances of V_0; * the last two show as an absolutely certain fact that C_0 can possess one value only in any locality to calculate accurate V_0. The C_0 given for the Irawadi are purely academic, though time may yet show that C_c is a general measure of the silt-load, *or at least, of the capacity of a current to carry silt.*

This concludes the eight main articles dealing with the P. K. Formula. A summary follows.

Σ. Φ.

Drafted : *November-December 1927.*
Revised : *6th January 1928.*

* The reader will have understood that any observed mean velocity of flow which is not exactly V_0 is a v, and therefore a different proposition.

CEMENT MORTAR *VS.* LIME MORTAR IN BUILDING CONSTRUCTION.

By A. K. DATTA, B. E., C. E., A. M. I. E.,
Consulting Engineer.

IN almost all building construction in India, lime mortar is used for brickwork, concrete and plaster. About three years back when the price of cement was reduced to about Rs. 40 per ton, some engineers decided to substitute weak cement for lime mortar, without increasing the cost of the structures. Many experiments were carried out to that effect, and it was found that cement mortar in the proportion 1 : 7 (1 cement : 7 sand) could safely be substituted for lime mortar in the building construction and also that cement mortar was found stronger both in tension and in compression than ordinary lime mortar. As a result of this investigation actual construction of buildings was commenced with 1 : 7 cement mortar instead of lime mortar for concrete, masonry and plaster constructions. The strength of cement mortar increases considerably with age. The strength is further increased when a small quantity of slaked lime is added to the cement mortar. In some constructions conducted by the writer, lime water was used for mixing 1 : 7 cement sand mortar. The result was found to be very satisfactory. A few months after no grains of sand on the exterior surface of the plaster could be extracted with the finger nails nor was it possible to drive any wire nails into the walls. The building was a double-storeyed one ; the plaster of the building was done along with the construction of the brickwork, so that the outside plaster was bonded by the mortar inside the joints of the brickwork. Precaution was taken to increase the durability of the plaster and building. Several buildings have been constructed at Benares city by Mr. R. N. Roy, Engineer and Contractor, with 7 : 1 mortar. These buildings are three-storeyed. No lime was used with the cement mortar in these cases. The buildings have stood very satisfactorily for the last three years, and practically no repairs, except whitewashing have been done in any part of the buildings. The roofs and floors of these buildings were made of reinforced brickwork slabs finished with a thin layer of concrete on the surface. The ground floor pavement was made with 3" R. B. work laid in 7 : 1 cement mortar with ¼"ᵒ rods every 10" apart embedded in 2½ : 1 mortar. The exterior surface was finished with 4 : 1 cement mortar, with a neat sprinkling of cement on this surface. The same sort of pavement was also used for the lanes in front of these houses. These constructions were examined by the writer two years after construction and were found to possess no cracks or defects. In the new surgical building, constructed at Ram Krishna home of Benares city, similar specification was followed in the construction with entirely satisfactory results. Several such buildings are now under construction at Benares and one of them belongs to His Highness the Maharaja of Mysore. From several actual constructions the writer is thoroughly convinced that 7 : 1 mortar can be safely used in building construction in the place of lime mortar. The precautions necessary are :—

(1) The mortar 7 : 1 proportion is to be first mixed dry and then wet—thoroughly ; unless this is done, it may happen that in some part of the mortar there may be excess of sand and no cement at all.

(2) The sand should be absolutely clean and free from dust, mud, etc. It is always advisable to screen and wash the sand well lest there be mud and other foreign matter in it.

(3) The mixed mortar should be used in the construction 15 to 20 minutes after wet mixing.

(4) Mixing of 7 : 1 cement mortar with lime water will improve the consistency and strength of the mortar.

(5) Set cement mortar must not be used in these constructions.

COST:—

COMPARISON OF LIME MORTAR WITH 1 : 7 CEMENT MORTAR.

The usual proportions of mortar in the building constructions are:—

(1)	Kunkur lime	1
(2)	Slaked lime	1
	Soorkhi	2
(3)	Slaked lime	1
	Cinder	2
(4)	Slaked lime	1
	Soorkhi	1½
	Sand	1½
(5)	Sand	7
	Cement	1

In items 1 and 5 the consumption of mortar in brickwork is usually between 32 and 36 per cent., or an average of about 33 per cent.

In items 2, 3 and 4 the consumption of mortar in brickwork is between 40 to 45 per cent., or an average of about 42 per cent.

ANALYSIS OF COSTS.

(1) The current price of kunkur lime is between Rs. 24 and 26 per 100 cubic feet, or an average of Rs. 25 per 100 cubic feet.

(2) Taking the rates of slaked lime at Rs. 40 per 100 cubic feet and soorkhi at Rs. 15 per 100 cubic feet, the cost of mortar 1 lime : 2 soorkhi per 100 cubic feet is Rs. 23-3-0.

(3) Taking the rate of cinder at Rs. 10 per 100 cubic feet, the cost of 1 lime : 2 cinder mortar is Rs. 20 per 100 cubic feet.

(4) Taking the cost of cement at Rs. 40 per ton (25 cubic feet) the cost of 1 : 7 cement sand mortar per 100 cubic feet is Rs. 25-4 only. 1 : 7 cement mortar when compared with lime mortar in cost proved very favourable and the result was the wide adoption of cement mortar in the place of lime mortar in building construction. Now the price of cement has risen again from Rs. 40 to Rs. 60 per ton and the cost of 1 : 7 mortar has risen from Rs. 25-4 to Rs. 35-4 per 100 cubic feet. On account of this sudden rise in the cost of cement, people are reverting to lime mortar again for their building construction.

The writer has contributed these notes to draw the attention of cement manufacturers in India to this point about the substitution of cement mortar in place of lime mortar in all building constructions. It is certain that if the price of cement is reduced to its former price, the consumption of cement will be greatly increased again owing to the general adoption of cement mortar in the place of lime mortar in all constructional works.

The Gazettes.

Burma, March 7, 1928.

Buildings and Roads Branch.

Leave on average pay for eight months and in continuation thereof, leave on half average pay for one year and eight months, for a total period of two years and four months, is granted to Mr. G. A. Grossett, I. S. E., Executive Engineer, Mergui Division, with effect from 24th March 1928, or such subsequent date as he may avail himself of it. The leave will be spent out of India and Ceylon. Mr. Grossett is permitted to retire from the service at the end of the leave.

Mr. Benarsi Dass, Assistant Engineer, Burma Engineering Service, is confirmed in his appointment.

Mr. W. E. Kingsley, Assistant Engineer, is transferred from the Mandalay Circle and posted to the charge of Public Works in the Andaman and Nicobar Islands, *vice* Mr. R. W. Lindsay, Assistant Engineer, proceeding on leave.

Leave on half average pay for six months on medical certificate is granted to Mr. J. L. Barua, Sub-Engineer, Rangoon Estate Office, in extension of the leave granted him previously.

Mr. A. J. R. Hope, C. I. E., I. S. E., Chief Engineer, Public Works Department, Buildings and Roads Branch, is permitted to retire from the service of Government, with effect from 25th June 1928.

Leave on average pay for eight months is granted to Mr. C. E. Scovell, I. S. E., Superintending Engineer, Mandalay Circle, with effect from 1st April 1928, or such subsequent date as he may avail himself of it.

Leave on average pay for three months on medical certificate is granted to Mr. H. K. Paul, Sub-Engineer, Tavoy Division, in extension of the leave granted him previously.

Leave on half average pay for the period from 23rd October 1927 to 5th November 1927 is granted to Mr. H. Marsland, I. S. E., Executive Engineer, in extension of the leave granted him previously.

Irrigation Branch.

Mr. L. G. Nunes, I. S. E., Superintending Engineer, entered upon his special duty in the office of the Chief Engineer, Public Works Department, Irrigation Branch, on 20th February 1928.

Leave on average pay for eight months and in continuation thereof, leave on half average pay for one month, for a total period of nine months, is granted to Mr. P. Lowson, I. S. E., Executive Engineer, Dredger Division, with effect from 8th March 1928, or such subsequent date as he may avail himself of it.

Mr. C. C. Mackintosh, I. S. E., Superintending Engineer, Northern Irrigation Circle, is, until further orders, appointed to the charge of the Southern Irrigation Circle, in addition to his own duties, *vice* Mr. L. G. Nunes, I. S. E., Superintending Engineer, Southern Irrigation Circle, transferred.

On completion of the special duty to which he was posted, Mr. L. G. Nunes, I. S. E., Superintending Engineer, is appointed to officiate as Chief Engineer, Public Works Department, Irrigation Branch, *vice* Mr. J. D. Stuart, I. S. E., Chief Engineer, Public Works Department, Irrigation Branch, proceeding on leave.

Leave on average pay for sixteen days is granted to Mr. L. S. Ahuja, Temporary Engineer, Salin Canal Division, in extension of the leave granted previously.

The probationary period of U Tha Kyi, Assistant Engineer, is extended up to 31st December 1928.

Mr. L. G. Nunes, I. S. E., Superintending Engineer, made over and Mr. C. C. Mackintosh, I. S. E., officiating Superintending Engineer, received charge of the Southern Irrigation Circle on 16th February 1928.

Mr. G. G. Knolles, Assistant Engineer, Burma Engineering Service, is confirmed in his appointment.

Punjab, March 23, 1928.

Irrigation Branch.

Mr. C. A. Colyer, Executive Engineer, on return from leave, landed at Bombay on 20th February 1928, and joined the Punjab Irrigation Secretariat, to which he was attached, on 22nd February 1928.

Mr. R. A. Routh, Executive Engineer, on transfer from the Burala Division, Lower Chenab East Circle, which he left on 4th March 1928, took over charge of the Sirhind Canal Circle of Superintendence on the 6th idem from Mr. A. G. C. Fane, M. C., Superintending Engineer, who proceeded on leave. Mr. Routh is appointed to officiate as Superintending Engineer with effect from 7th March 1928.

M. Mohammad Said, Temporary Engineer, attached to the Jandiala Division, Upper Bari Doab Canal, is allowed leave on average pay for 8 months, from 15th March 1928, or subsequent date.

Mr. W. E. Flewett, Deputy Conservator of Forests, on retransfer to the Forest Department, left the Public Works Department, Irrigation Branch, on 28th February 1928.

Lala Behari Lal Uppal, Executive Engineer, on transfer from the Gujrat Division, Upper Jhelum Canal, took over charge of the Muzaffargarh Canals Division, Derajat Circle, on 8th March 1928, from Mr. S. N. Herdon, Temporary Engineer, on return from leave.

Mr. T. B. Tate, Superintending Engineer, Bikaner Circle, is allowed leave on average pay for 3 months and 9 days and in continuation leave on half-average pay for 2 months and 6 days, from 3rd May 1928, or subsequent date.

Mr. H. F. Merrington, Assistant Executive Engineer, on transfer from the Islam Division, 3rd British Circle, Sutlej Valley Project, which he left on 22nd February 1928, joined the Panjnad Weir Division, 3rd British Circle, Sutlej Valley Project, on the 28th idem.

Lala Ishar Dass, Assistant Engineer, on transfer from the Western Bar Division, 2nd British Circle, Sutlej Valley Project, which he left on 24th February 1928, joined the Khadir Division, 2nd British Circle, Sutlej Valley Project, on the 26th idem.

Sheikh Mohammad Sharif, Assistant Executive Engineer, on transfer from the Burala Division, Lower Chenab East Circle, which he left on 1st March 1928, took over charge of the Lower Gugera Division, Lower Chenab East Circle, on the 14th idem, from Rai Bahadur Lala Hukam Chand, Executive Engineer, transferred.

Rai Bahadur Hukam Chand, Executive Engineer, on transfer from the Lower Gugera Division, Lower Chenab East Circle, which he left on 3rd March 1928, took over charge of the Burala Division, Lower Chenab East Circle, on the same date, from Mr. R. A. Routh, Executive Engineer, transferred.

Pandit Khushi Kam Sharma, Assistant Engineer, on transfer from the Jhang Division, Lower Chenab West Circle, which he left on 29th February 1928, joined the Sargodha Division, Lower Jhelum Canal, on 2nd March 1928.

Notice.

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CONTENTS

INDIAN ENGINEERING.

SATURDAY, APRIL 7, 1928.

INDIAN ARCHITECTURE. *

IT is not altogether easy to understand why a second edition of Mr. Havell's work entitled "Indian Architecture," published in 1913, should be required. At the time the first edition issued the author had a special motive, the motive of telling Government how New Delhi should be designed and constructed. A very genuine lover of Hindu art and a wholly disinterested advocate for the employment of the Hindu master-builder, he pressed with great vigour the claims for the building of the new capital of India by the craftsmen of the country in accordance with their old traditions. To the book was appended a memorial signed by stock notabilities, there were only four Indian names in the list, there was nothing to show that the Indian artists wanted their cause pleaded for them, and as for the other signatories, with all respect to eminent people like Sir Oliver Lodge, Thomas Hardy and Bernard Shaw, what did they know about it? Mr. Havell was, however, a force; he derided Fergusson, generally regarded as an authority; he dragged in Macaulay to be reproved; professional architects with their "paper patterns" were given a bad time; and the poor engineers of the Public Works Department were rebuked for their suppression of the glories of Indian art. Everyone was wrong except, it may be presumed, Mr. Havell and the men whose right to build New Delhi he supported very eloquently. We honour Mr. Havell for his love for the old indigenous art of the country, there is much that is both beautiful and attractive in it; but to most people the idea was fantastical, it was impossible to revive the ancient traditions, there was the question of expense, the question of suitability to modern conditions, and where were the master-builders to be found? They were not in evidence anywhere. Buildings should express the conditions of their own time, and a twentieth century Delhi had to convey the spirit of the Government of India at its date, with the immense moral and social progress that lay behind it, and the unity between British and Indian sentiment which had not existed in the same sense before. But, though there were many opinions as to the style in which the capital should be built fourteen years ago and opinions also as to the most appropriate site, there is no object now in reviving by-gone controversies. New Delhi has been built, and whether it is liked or not, it has to be accepted.

For the rest, Mr. Havell has always had his views about Indian art and architecture, it may have been Hindu or Mahomedan, but to him it is just characteristically Indian, emanating from one source. It is difficult to follow him in that contention. There could hardly be a more striking contrast to the old Hindu style in the Indo-Saracenic work introduced by the Mogul conquerors. The beautiful sculpture in the form of images, the great feature of Hindu architecture,

* Indian Architecture. By E. B. Havell. Second Edition. 1927. John Murray. 42s.

was of course anathema to the followers of the Prophet, and that alone was an element of distinction. But it was by no means all, in the liberal use of the arch, the employment of the minaret in the enrichment of surfaces with inlay and colour, and in the general composition of grouping and proportion, the Saracenic style differed very materially from the Hindu. Hindu craftsmen were employed as a matter of course, but employed under orders, just as indigenous talent was used in any country that the Mahomedans conquered. Along the Mediterranean littoral as far as Spain, in Persia and Central Asia, anywhere that their victorious arms carried them, their style of architecture was peculiarly conservative and of very distinctive type, although everywhere they compelled the labour of the countries they overran. They did so in India, and no doubt to the skill of Hindu craftsmen their buildings owe much of their great beauty. But the main design was Mahomedan, and the Indo-Saracenic masterpiece in India, the Taj Mahal, shows no influence of Hindu tradition. There are Saracenic edifices in which a Hindu treatment is clearly discernible, but not in the Taj nor in many other buildings as, to take another example, the tomb of Itmad-ud-Dowlah. Mr. Havell holds, however, to his former views, and the second edition of "Indian Architecture" follows the first edition in its essentials, though it has a new and final chapter entitled "Fourteen Years After."

Nevertheless, it might be said that the work is well worth reading, it is beautifully and profusely illustrated, and the text is full of life. Sometimes, too, it is good for us to hear the views of others even though we may not be in agreement with them. But Mr. Havell might have been a little more fair. He is unfair on the engineers, he says for instance: "It is no justification of a Public Works system of architecture, based upon a misreading of history, bad art, and pseudo-science, to say that it is British." No one, as far as we are aware, has ever justified Public Works architecture on that ground, nor was it architecture based on a misreading of history, art, or pseudo-science. It may frankly be admitted that the architecture of the engineers was anything but good, they were engineers and not architects, and it was not their fault that they were required to do work for which they had not been trained. And their buildings, constructed at the cost of India, were cheap. In cheap bungalows and offices, they lived and worked and often died, and no heavy tax upon the people was imposed for the glorification of a British Government. If they built a church in a cantonment it was a cheap church, the Code of those days did not admit of anything much more than a barn; but if it was not as beautiful as a Hindu temple or a Mahomedan mosque, the people had not to pay for splendid edifices at the command of a king. It is not very clear what Mr. Havell means by "pseudo-science," the engineers had been taught the science of engineering and it was not a pseudo-science. They had not misread history or art, they never thought of either when they built. They just built for absolute needs and they built cheaply, in pursuance of a definite policy.

SHAKESPEARE MEMORIAL THEATRE.

THE remarkable triumph achieved by Miss Elisabeth Scott in securing the award for the best design for a new Shakespeare Memorial Theatre at Stratford-upon-Avon, to replace the old theatre which was burnt down in 1926, has been the subject of much comment in the Press. The competition was open not only to Great Britain, but also to the United States of America where there are many fine architects, and seventy-two designs were submitted. Of these, six were selected and returned to the competitors for any further elaboration or alteration they might wish to make before a final decision was reached, and in the final competition Miss Scott's design was chosen by the assessors as most suitable. The assessors said among other things in their report: "The assessors have unanimously chosen design No. 3 (by Miss Elisabeth Scott) as the most suitable design submitted. They consider that design No. 3 in its general conception, in its acceptance of the site difficulties and their solution, and in its architectural character shows great ability and power of composition. It has a largeness and simplicity of handling which no other design possesses. Its general silhouette and modelling to fit the lines of the river are picturesque, and the character of the design shows consideration for the traditions of the locality." The assessors were men of ability, they were Mr. E. Guy Dawber, a past President of the Royal Institute of British Architects, Mr. Raymond Hood of New York, and Mr. Robert Atkinson, Director of Education, Architectural Association, and their choice was accepted by the Governors of the Memorial Theatre.

On the announcement of the result of the competition, there was no lack of warmth in the congratulations Miss Scott received. There are a good many lady-architects in the profession now, but she was the only woman who took part in the competition; she is young, only twenty-nine years of age; if all the runners had been known, it is hardly to be supposed that she would have been a favourite in the betting; nevertheless she beat all the men, and England which always takes such events in a sportsmanlike spirit was most cordial on the win. It was appropriate that it should have been so. Women have entered professions which used to be exclusively the province of men, in architecture there seems to be no reason why they should not excel, and on the principle "let the best win" Miss Scott's success was greeted with acclaim. But that being the position, it is a little sad that on the publication of the illustrations of the successful design in the Press there should have been adverse comment. *Quot homines, tot sententiæ*, and in architectural matters especially there will always be differences of opinion; but all the same, though everyone would have been glad if the accepted design had met with general approval, there would seem to be some grounds for the hostile criticism.

It is—or it used to be—a principle of architecture that a building should express its intentions; that is to say the exterior expression of a home should suggest a comfortable home, the exterior of a bank should

convey solidity and strength to command confidence, and that the exterior of a music-hall should lead those who enter to expect gaiety within. We should not like our home to look unhomely, we should feel that we should not be happy in it; we should not like a bank to look frivolous or we should hesitate to place our deposits there; a music-hall would not entice us if it looked dreary when we wanted to be cheered; hotels would not attract if they promised cold welcome; and a skittish-looking church is not a place to which we should repair for worship. In that sense, what does the design for the Shakespeare Memorial Theatre suggest? The critics in the main have said that it resembles a fort, a mud fort on the north-west frontier of India, or a massive medieval fortress against the ramparts of which had been added at a later date dwellings of a modern French *pension* type at irregular intervals. One critic remarked that as a county gaol or a family mausoleum on a large scale in a suitable locality there would certainly be praiseworthy points about it, but for what it is intended to be, he asked, could anything more jarring to the surroundings have been devised? It would certainly be difficult to say that it suggests a theatre, or that it suggests Shakespeare, or the traditions of Stratford-upon-Avon of a Tudor time; and the Bard of Avon, if he were alive, might be imagined as regarding it with dismay, not as a building for the production of his dramatic art, but as a gloomy structure in a dungeon of which he was, dead or alive, to be immured at the caprice of a great Queen. Centuries of neglect and exposure to the elements would eventually give a picturesque appearance to the irregular mass, but it would never suggest a theatre or anything associated with the name of the greatest poet of any time.

The style is typical of the modern-day revolt against tradition, fostered by the Architectural Association and apparently encouraged by the Royal Institute of British Architects. And here, we recall what was once said by an architect. He said that he was not preaching the "Right Divine" of ancient styles, but the value of tradition, and he was not afraid of the word "convention." Convention might be said to be the bane of originality, but it is the very beginning of artistic expression. Much depends on what is meant by convention; the architect, referred to, said that he meant "treatment," treatment according to the conditions of the particular art in question and the particular problem before the artist. The artist has everything to learn from tradition; nature the great source and fountain head of inspiration will not teach it to him. It is out of his familiarity with the way others have treated design that he will be likely to evolve a treatment of his own. But, perhaps, at the present time all that will be stigmatised as hopelessly archaic and out of date. The vogue of the day is to discard tradition, the motto is "let all things be new," and so we have jazz in music, cubism in painting, Epstein in sculpture, but whether that form of art is appropriate for a Shakespeare Memorial Theatre our readers from the pictures they have seen can judge for themselves.

THE RIDES OF MAYMYO.

MAYMYO, the summer headquarters of the Government of Burma, is one of the most charming of hill-stations. It has no great elevation, it is true, but at its hottest, the heat is never anything to complain about; and then it has the advantage that it is not like the hill-stations of northern India, clinging to rock, perched high up in the clouds, it is on a plateau of the Shan Hills, and the plateau is very fair to look upon. It is undulating and very green. There are forests and brooks, the half-timbered houses nestle in the trees, the soil is so fertile that the place is a gardener's paradise, and the gardens are ablaze with flowers. The forests are full of life, there are jungle fowl, partridge, peafowl, barking deer, pig and leopards. There is a lake, and there are botanical gardens, tennis courts, golf links and polo grounds, and among the other attractions are the forest rides, a special feature of Maymyo. Everyone loves Maymyo, and those who are so situated that they can now only love it in recollection will welcome the little brochure, entitled "The Green Rides of Maymyo," which it is understood was written by Sir Harcourt Butler, late Governor of the Province.

The Forest Rides were due to Sir Hugh Barnes Lieutenant-Governor of Burma in 1903-05. Maymyo existed before that time, but in 1903 it came to be officially recognised as the hot-weather headquarters of the Government. The plateau was then largely covered by forest and dense undergrowth, and much clearance had to be done to provide sites for houses in the extension scheme contemplated. The plateau wanted opening out, and it was in pursuance of the general scheme that it occurred to Sir Hugh Barnes to cut roads through the forest areas. He was assisted by his Private Secretary, Mr., now Sir Godfrey, Fell, his Chief Engineer and P. W. D. Secretary, Mr., afterwards Sir Lionel, Jacob, Mr. Edward Gabbett, the Executive Engineer of the Maymyo Division, and Mr. Slade, the Forest Officer. The first ride was called "Barnes Ride" after the Lieutenant-Governor, and "Angel Corner" was named after Mrs. Angela Mallaby, sister of Lady Barnes. It had been the custom in Maymyo to associate the houses built for the officials with the names of their first tenants. Thus Mr. Gabbett's house was called "Ballygabbett" and the Chief Engineer's quarters "Jacobstowe." The opening up of the roads in the heavily timbered ground followed that happy procedure. The "General's Ride" suggests General Sir Donald McLeod, the first General Commanding in Burma to have a house built for him at Maymyo. "Jacob's Ladder" was the name given to a road down a fairly steep hill after Sir Lionel Jacob. "Moira Vale" was called after Miss Moira Gabbett, the daughter of the very popular and able Executive Engineer who did a great deal of good work at the station. "Fanny Mead" was called after Miss Frances de Benery; "Elephant Point" recalls Mr. Dalrymple Clark who was then in charge of the Government Kheddahs; "Forteath Ride" was named after a Coopers Hill Forest officer; "Bell Alley Ride" took

its name from Mr. G. H. Bell, one of the engineers at the station; "Slade Ride" was called after Mr. Slade of the Forest Service, the first Forest Officer to take a part in the operations. And so in other cases, the names are all suggestive of something or someone at Maymyo, when the new summer seat of the Government was in course of formation. The rides beginning in a small way are now about a hundred miles in length. They began with Sir Hugh Barnes, Sir Harcourt Butler, after whom the "Harcourt Butler Lake" is named, afterwards took a great interest in them, they were badly wanted, and the pamphlet describing them is a most readable little publication.

THE EIFFEL TOWER.

It is stated that the Eiffel Tower, the tallest structure in the world, which has been such a landmark in Paris for nearly forty years, is about to be dismantled. It was called the Eiffel Tower after its designer, the late Alexandre Gustave Eiffel, who died at the age of ninety-one a little over four years ago. The general belief is that the Tower was built as a *tour de force* for the purposes of the Paris Exhibition of 1889, and certainly it was a *tour de force* for its height, 984 feet, dwarfed all the other tall monuments of that day. The Washington Monument is 555 feet high, the tower of the Ulm Cathedral 528 feet, the Great Pyramid of Egypt 482 feet, Strasburg Cathedral 468 feet, the cross on St. Peter's at Rome 435 feet, Salisbury Cathedral 404 feet, and St. Paul's which seems to loom so large in the City of London only 364 feet. It was not the day of skyscrapers, but even taking modern skyscrapers into account, the Eiffel still holds the record. But M. Eiffel, it is believed, did not suggest his amazing structure from any grandiose spirit of display. He was an engineer and a scientist, and appears to have been a serious man of no freakish turn of mind. As an engineer, he had made metal construction a speciality. He had designed many important iron bridges for France and other countries, also roofs for very large railway stations, and when he offered to build the Tower that goes by his name, it is probable that he had some serious view in mind. It may have been that he wanted to see what could be done in that way as a test, or that he wanted the height for meteorological research. He certainly used it for research, and subsequently applied the results of his observations to the cause of aviation. He was skilled in the subject of aero-dynamics, and designers of flying machines were indebted to him for many suggestions. The Tower was therefore quite a fitting monument to a great man, but M. Eiffel never regarded it as a structure for all time. It is said that he estimated its life at twenty years, unless the Government cared to encase it in concrete in order to preserve it. It has not, however, been given that protection, and there has been a large annual expenditure on painting to prevent corrosion and in other ways. In spite of all such precautions, experts appear to be of opinion that the Tower is becoming a danger and that it should be dismantled to save collapse. If that is so, it is right that the Tower should go, though no doubt its loss will be regretted. It has served its day, it has taught engineers a good deal in iron construction, it has been used as a wireless station, for which its height made it useful, and it has proved to be of utility in various ways. If it really is a danger, its automatic fall would be a calamity in a crowded neighbourhood, and people will remember the great engineer who designed it, even if it disppears as a feature in the skyline of Paris.

MOTOR-CAR AND AEROPLANE RECORDS.

Two events of last February, within a few days of each other, have given to the British Empire the prestige of achievements which constitute world's records. On the 19th February, Captain Malcolm Campbell succeeded in breaking the previous car record by achieving a speed of 220 miles an hour on the beach track in Florida. Put in that way, it is possible that the feat may not sound so very much; but if we let our minds dwell on it, the feat must certainly be regarded as a matter of congratulation for both the manufacturer of the machine and the intrepid driver of it. It has to be remembered that the motor-car is an affair of only a few decades ago, and therefore the machinery improvements that have since been made to enable a car to attain the speed above mentioned with any sort of safety are nothing short of amazing. It was of course a racing car specially designed for speed, but that does not matter, it is by aiming at a perfection of machinery for the purpose of world's records that cars and motor vehicles of all descriptions are improved. Nor must the skill and courage of the driver be forgotten, however perfect the machine and however great its possibilities of accomplishment, a speed of 220 miles an hour is so tremendous that any failure of nerve or other cause leading to an accident is almost certain to be attended by fatal consequences. The other event is the flight of Mr. Bert Hinkler from Croydon Aerodrome in England to Fanny Bay, five miles from Darwin, in Australia, a distance of 12,000 miles, in sixteen days, which is also a record. Mr. Hinkler left Croydon at 6-48 A. M. on the 7th February and reached his distination at 5-55 P. M. (Australian time) on the 22nd February, travelling at an average speed of 92 miles an hour. The aeroplane was moreover an ordinary Avro-Avian light aeroplane, with a Cirrus engine, designed for a speed of 100 miles an hour, at a cost of less than £700. It had been predicted that in the most favourable circumstances the journey might possibly be made in seventeen days but more probably the time would be three weeks. In this case also, the record flight achieved is a triumph for both machine and pilot. The Avro-Avian 'plane and Cirrus engine behaved splendidly, and the pilot was able to maintain a cruising speed of twenty miles to the gallon and over 90 miles an hour. He flew for 10 hours and more in a day without a stop, in a cramped cock-pit, with little food and drink, and had of course to navigate and watch his instruments all the time. One portion of the trip was the passage of 420 miles of open and unfrequented sea, and altogether Mr. Hinkler displayed great skill, courage and endurance in the stress and strain of so long a flight. It was a great feat, and the Empire will necessarily be proud of Mr. Hinkler as of Captain Campbell for the records they have established.

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Notes and Comments.

Aerial Survey.—The aerial survey operations of the river Kornafuli and its approaches have begun at Chittagong. The whole course of the river and some portions of the coast will be surveyed. Following this, the current of the river at Kaloorghat will be surveyed at the instance of the Assam-Bengal Railway, with a view of selecting a site for a bridge in connection with the railway's proposed extension towards Burma.

G. I. P. Railway.—The revision of rates and fares laid down in the Government of India budget memorandum for railways will be introduced on the following dates:—Abolition of third class mail fares—In local booking, 1st March 1928, in through booking, 1st May 1928. Abolition of intermediate mail fares—In local and through booking, 1st May 1928. Reduction in third class fares for distances above 50 miles—1st May 1928. Remaining reductions in rates—1st June 1928.

Coal Accumulations.—The latest colliery reports show that stocks are now accumulating rapidly all over the coalfields, and it is anticipated that several collieries will have to restrict raisings in the near future. The Bengal Coal Company have nearly 200,000 tons on the ground. There is no change in the position of sea-freight and the scarcity of steamers is a serious matter to the coal trade. There are enquiries out for at least eight cargoes representing about 60,000 tons, but there is nothing offering for either March or April.

British Railways Companies.—Great rivalry exists regarding non-stop runs between the London and North Eastern Railway Company and the London and Midland Railway Company. The former is contemplating a non-stop run from London to Edinburgh, a distance of 395 miles. The latter company are also contemplating a non-stop run by the West Coast route, a distance of 400 miles. To relieve the strain on drivers and firemen it is intended to build an engine with a corridor attached to it, so that the staff can be changed without stopping the train.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 21st March 1928:—Messrs. Worthington-Simpson, Ltd., Bombay—2 Pumping Sets, centrifugal, for Jacobabad, 20/22 b. h.-p. cold starting engine, 310 r. p. m., coupled to horizontal pump, Rs. 9,386 f. o. r. Karachi including erection and test at site; Messrs. F. and C. Osler, Ltd., Calcutta—20 Accumulators, "Exide," 6 volts, 70 amperes, Rs. 1,545 free delivery at railway station, Chaklala, by 17th April 1928.

Industrial Research Laboratory.—Few people are aware of the important part played by this institution in aid of industries in Bengal. This laboratory situated at Pagladanga, only a few miles from Calcutta, has been holding demonstrations since April 1927 to March 1928 for the benefit of the soap and lac industries in Bengal, which have been provided for and await the approval of Government and the allotment of funds. The work is directed by Dr. R. L. Dutta and the assistance given and inquiries answered embrace a very wide range of industries.

Calcutta Corporation.—The Government of Bengal have appointed the following ten persons to be Councillors of the Corporation of Calcutta for a period of one year with effect from 1st April 1928:—The Chairman of the Calcutta Improvement Trust, *ex-officio*; Mr. L. T. Maguire, M. L. C.; Mr. K. C. Rai Chandhuri, M. L. C.; Captain Hadji Dabiruddin Ahmad, I. A. R. O.; Mr. P. N. Guha, M. L. C.; Miss L. I. Lloyd; Mr. Gholam Hossain Shah, M. L. C.; Mr. Surendra Mohan Basu; Rai Debendra Nath Ballabh Bahadur, and Mr. Charu Chandra Biswas.

High-speed Flying.—A number of Royal Air Force pilots have already volunteered for membership of the new high-speed flying section, from the personnel of which will be chosen a pilot to fly the Supermarine Napier S-5 monoplane at Calshot, in the second attempt to gain the world's speed record. Attempts on other air records will also be made within the next few weeks. For an altitude attempt a Bristol biplane of special construction driven by a supercharged air-cooled engine of immense power is now undergoing final adjustments. A special craft is being designed to set up new standards of long-distance and duration flying. It is anticipated that this machine will raise the distance record by about 1,000 miles to approximately 5,000 miles.

Aero Club of India.—The annual general meeting of this club was held at Delhi on the 23rd instant. Sir Victor Sassoon presided, and said that the outlook for the present year was brighter and offered to meet the deficit of 1927 and also to pay the running expenses for the first quarter of 1928. Speaking of the activities of the club, he said that they had concentrated on the foundation of flying clubs in Delhi, Allahabad, Calcutta, Bombay and Karachi. They now proposed to study the question of the provision of increased facilities for learning flying in the country. The Technical Committee has decided that the Government subsidy of Rs. 30,000 should be spent on equipping the clubs with Moth aeroplanes. The machines were expected early in the autumn, so that next cold weather the clubs would be engaged in active flying. A meeting of the new executive committee was held in New Delhi on the 26th March last. Sir Victor Sassoon was elected chairman and Mr. Sams vice-chairman. The Finance Committee was formed consisting of Mr. Pasricha, Mr. Aruamudda Iyengar, Mr. Marsh and Colonel Alexander.

Calcutta's Technical School.—This new school, situated at 110, Corporation Street, is giving a valuable training to large numbers of technical men employed in Indian industries as well as in the public services. It is well equipped, and with ample room for expansion it gives technical training to apprentices. The ground floor comprises two lecture theatres, each with accommodation for 100 students, two laboratories, five class rooms, lecturers' rooms, offices and workshops. A large machinery hall will be added to assist instruction in the subjects of steam, internal

combustion engines, pumps and electrical engineering. The present resources for instruction in physics are as adequate as any of their kind in India. The first need catered for is the training of engineering apprentices; but as the school develops it will be possible to inaugurate other types of technical instruction.

Calcutta's Water Supply.—With the exception of 800 feet in Paikpara Road the laying of 68,100 feet of new water mains along the Barrackpore Trunk Road for Calcutta's new extended water supply scheme has been completed. The project is to extend the city's water supply from 37,000,000 gallons to 89,000,000 gallons per day. The estimated cost of the scheme was Rs. 265 lakhs of which Rs. 175 lakhs has been spent. The completion will ultimately be achieved at a cost well inside the original estimate. The Barrackpore Road is being treated with tar macadam, with pucca stone edging on each side to a width of 16 feet from the approach at Chitpore railway yard to the ninth milestone. Arrangements have been made to take in the stretch between the ninth and thirteenth milestone at an early date by the Public Works Department. The work will be started shortly.

Survey of India.—Colonel-Commandant E. A. Tandy, R. E., Surveyor-General of India, is to be congratulated on the remarkable achievement of his Department in having completed, within a period of three years, under difficulties and with strenuous hard work, the topographical survey and exploration of the territory of Nepal, and the preparation of a complete contoured map of this most conservative country. The results of the survey, undertaken at the request of the Prime Minister of Nepal, are published as an Appendix to Colonel Tandy's report for 1926-27. The area surveyed covers 55,000 square miles and extends over some of the greatest mountains of the world, and includes the highest known peak, Mount Everest, 29,300 feet above sea level. A skeleton map of Nepal is also published in order to furnish geographers with the main outlines of the country. The work constitutes a valuable addition to geographical knowledge.

Aircraft and Survey Work.—Wide and varied are becoming the duties to which aircraft is placed. One of the fields for which there is a growing demand is that of survey work, and much has been carried out in this direction in Canada, America and Australia. Quite recently the Great Barrier Reef, which covers an area of some 100,000 square miles off the coast of Australia, was successfully surveyed by the Commonwealth Government of Australia with a fleet of Supermarine-Napier Amphibian flying machines. Now news has been received that the Anglo-Persian Oil Co. have just concluded a season's air survey of Papua with two Supermarine-Napier "Seagulls." An area of 10,000 square miles was covered with the purpose of investigating the general structure and extent of tertiary formations in which oil had previously been discovered. In such work as this where the aircraft are working for long periods away from their base, much of the success depends on the engine. The machines in question are fitted with British-built Napier engines, whose reliability in the air has done much to place Great Britain in its present enviable position in the aviation world.

Largest Boilers Ever Made.—The largest boilers yet made in Britain, if not in the world, have recently been constructed by William Beardmore and Co., Ltd., the Steel Manufacturers and Engineers of Glasgow. They are for extensions to the Prince's Generating Station for the Birmingham Electric Supply Department under contract from Simon-Carves, Ltd. There are four of these boilers, and each will be capable of a normal rated evaporation of 150,000 lb. of steam per hour, and 180,000 lb. per hour on overload. They will work at a pressure of 320 lb. per square inch at the superheater outlet, from feed temperature of 180 deg. F., the final temperature of the steam being 700 deg. F. at the turbine stop valve. The boilers are fired on the Simon-Carves "Central" system of pulverised coal. The total nett effective boiler heating surface is 21,140 square feet, of which 4,700 square feet is formed by the combustion chamber water cooling elements.

Civil Aviation Scholarships.—In pursuance of the decision sanctioned by the Standing Finance Committee, the Government of India invite applications for three scholarships, each of the value of £240 a year (exclusive of college fees, premium for flying, training, travelling expenses, etc., which will be defrayed by the Government), tenable in England for a period of three years for training in civil aviation. Candidates for the scholarships must be not less than 20 or more than 25 years of age on 1st July 1928. The minimum educational qualification required is the B. Sc. degree, preferably in Engineering, of an Indian or British University, or its equivalent. Applications in the prescribed form will be received up to 25th April 1928 by the Secretary, Government of India, Department of Industries and Labour, from whom copies of the form of application, with a copy of the detailed rules and conditions, applicable to the grant of the scholarships, may be obtained.

Calcutta Electric Supply Corporation.—Calcutta has become the possessor of the largest electrical sub-station in India at a cost of £110,000. Another scheme which cost Rs. 5 lakhs has just been undertaken to meet the ever-growing electrical demands. The new sub-station of this Corporation is a sequel to the development of Central Avenue and the Burra Bazar area and will relieve the load upon the sub-station supplying the city areas. The building has been designed for seven 2,500-kilowatt motor converters, and at present the installation consists of three 1,000-kilowatt sets and one 2,500-kilowatt set is in course of construction. The supply to this sub-station is received both from the Cossipore generating station and the southern station at 6,000 volts, three-phase, and is converted to 450 volts direct current for supply to the various consumers. When the new mains are laid this Corporation will have in all little short of 1,000 miles of underground cable which serves 40,000 consumers of current.

International Railway Congress.—It has been arranged, writes "Civil Engineering," that this will be held at Madrid in 1930. The following are some of the subjects that will be discussed :—The use of concrete and reinforced concrete on railways; resistance of rails against breakage and to wear; investigation into static and dynamic stresses in railway bridges;

recent improvement in permanent way tests and in the scientific organisation of maintenance work; locomotives of new types, in particular turbine locomotives and internal combustion motor locomotives; improvement in the steam locomotive; electric locomotives for main line traction; all-steel coaches—comparison with vehicles built of wood; relations between railways and seaports; methods to be used in marshalling yards to control the speed of vehicles being shunted; signalling; economical traction methods for use in particular cases; competition of road transport; light railways; electrification of secondary lines; rail motor vehicles, etc.

Thornycroft Marine Motors.—Some extremely interesting figures were recently published in a British motor boating journal, giving the annual outputs during 1927 of the principal British manufacturers of marine motors, when the growing ascendancy of Thornycroft motors was revealed. The total output for the past year was approximately 18,300 h.-p. which is nearly 50 per cent. in excess of the next largest total output of other makes published. Perhaps more interesting still is the news that an increasingly large proportion of Thornycroft motors are for service overseas, particularly of their famous "Handybilly" 7½-9 engine which has proved so extremely successful since its introduction some two years ago. Commencing with this smallest unit the Thornycroft Marine Motor Works at Reading are now producing a very complete range of types up to their 12-cylinder 375 b.-h.-p. type constructed expressly for high speed coastal motor boats. In these progressive days when standardisation is so strongly advocated it is highly creditable that John I. Thornycroft and Co., Ltd., can maintain their pre-eminent position amongst British marine motor engineering firms with their very comprehensive manufacturing programme.

Tendencies of British Design.—As regards the products of the British Motor Industry, the last Olympia Car Show indicated refinement rather than revolutionary change, the aim of manufacturers being to secure smoother and quieter running without lowering the standard of performance or increasing prices. Easier maintenance follows as a natural corollary. In the sphere of the commercial vehicles, the most outstanding development is that of the rigid six-wheeler, a type which will be of great value, particularly in the overseas markets, for the carriage both of goods and of passengers. It must not, however, be supposed that the normal four-wheeled vehicle is becoming by any means obsolescent. The six-wheeler can advantageously replace it in some quarters but certainly not in all, and at the same time can create a new demand for transport services operating under conditions to which no ordinary four-wheeler could possibly be really suited. Considerably more attention is being given by many manufacturers to the production of light vans available at low cost. One notes also a tendency to lower the loading level of vehicles for all purposes, coupled, in the case of passenger-carriers, with the more general use of a totally enclosed upper deck, the fitting of which gives the maximum protected accommodation consistent with the limitation of vehicle dimensions that is desirable under most circumstances.

The Assuan Dam.—The Ministry of Public Works, Cairo, is at present occupied with studying various schemes for heightening this dam and is expected to be ready to convoke an independent Commission to give final advice this month. This Commission is to be international and will include British engineers. "The Times" states that the terms of reference will ask for the opinion of the Commission as to whether the heightening of the dam by seven metres (almost 26 feet), in order to double the present capacity of the reservoir, will be safe and practicable and whether it will be possible to fill the enlarged reservoir during years when the water level is abnormally low. It is probable that the Government will take advantage of the presence of the experts to seek advice regarding the important work in connection with the existing Nile barrages, which will be necessary in the near future in order to meet the growing needs of the Delta and of Middle Egypt. Sir Murdoch Macdonald, former Adviser to the Ministry of Public Works, who is in Cairo in connection with his firm's scheme for heightening the Assuan Dam, which is among those being considered by the Department, says that "if certain theoretical considerations are duly met the proposed heightening is a safe, simple and economical proposition." It was he who in 1905 suggested the amount of the original heightening which was completed in 1912. He had fixed that amount because the "aprons" of the dam were then in an experimental stage, and although he himself had no fears, doubts had been expressed as to their stability. These doubts have since turned out to be unfounded. With the "aprons" as a stable and integral part of the structure Sir Murdoch sees no reason why further heightening, if such be necessary, could not be carried out with safety.

The Coast Lights of India.—The report on "Lighthouses in India, Burma, Persian Gulf and Ceylon" by Mr. D. Alan Stevenson, F. R. S. E., M. Inst. C. E., is the outcome of the employment of this expert, due to the contemplated reorganisation of the lighthouse system in India, to make a tour of inspection of the coast lights and to advise regarding them. Mr. Stevenson considers that the only way to deal satisfactorily with the interests of navigation in India is to instal a system of wireless beacons, which might also prove cheaper than to carry out improvements of lighthouses, lightships, fog signals, buoys, and to establish some new and desirable seamarks. He says that in a clear atmosphere, a light of low power can be seen practically as far as the most powerful light, and in thick weather even the most powerful light is blotted out at a distance of, say, half a mile or less. In medium weather the most powerful light has a considerable advantage over the low-powered one. The range of high-powered lights under good weather conditions is, owing to the curvature of the earth, restricted to about 20 to 25 miles, depending on heights of light and observer. There is little meaning in the expressions "Twelve-mile light" or "Twenty-mile light" when applied to lights beyond ten miles range; and the weather conditions, which affect adversely the carrying power of lights to the seaman, do not affect the range of wireless beacons and exact bearings can be made on a ship from a distance of a hundred miles. Mr. Stevenson has recommended that a wireless beacon installation should

be obtained at once for actual trial under working conditions; and as buildings are available at Vengurla Rocks and Table Island, both permanent sites for lights, he proposes these as test stations. If the trials give favourable results, wireless beacons can afterwards be introduced all round the coasts, and in view of such developments Mr. Stevenson advises no increase in lighthouse establishment as quite another class of men, trained in respect of operating wireless plant, might eventually be required. It thus seems that a new era is coming on the coast lights of India, and as the old lights, though improved from time to time, are becoming out of date and call for much expenditure, wireless may solve the never ending problem of improvements.

Death of a late Chief Engineer in Bengal.—We much regret, as a great many friends of his will also regret, to hear of the death on the 4th of March last of Mr. Mackay John Scobie, an engineer who served a full service in the Public Works Department of Bengal. Mr. Scobie was a Coopers Hill engineer of the 1876 batch, at the time he passed into the Royal Indian Engineering College competition was keen and Mr. Scobie had no doubt good general abilities, though at the College he was more known as an exponent of Rugby football and one of the most popular of good fellows than for his scholastic qualifications. He was not a great engineer in India, but that did not prevent him from rising to the rank of Chief Engineer and Secretary to Government in his province. His personality possibly did that for him, for he was one of the most lovable of men. No one was more free from guile of any description, he was sturdy in constitution, hard-working, loyal and always out to do his best whatever the circumstances. Sir Andrew Fraser, the Lieutenant-Governor of his time, had an immense affection for him, though—so it was said—in the Calcutta days he used to ask the Public Works Department Secretary to the Government of India of that day to drop in and oblige him with an opinion on something or other that Mr. Scobie had recommended. With all his fondness for Mackay John, Sir Andrew had sometimes a little doubt about his technical ability. But it all had to be done very surreptitiously, not for all the world would Sir Andrew hurt Mackay John's feelings, so the Government of India Secretary advised on the quiet, and Mr. Scobie used to say that the Lieutenant-Governor had a wonderful knowledge of engineering. The secret transaction only seemed to bind the two more closely together, and the story serves to show how affectionate were the sentiments for Mackay John on the part of all who knew him. He was always eager and willing to do anything to help anyone else, and everyone was glad to do anything for him. Sir Andrew treated him as a valued friend, and if Mr. Scobie received no honour on retirement, he retired in the odour of sanctity with the best of good wishes from the wide circle of his friends and acquaintances. In England, Mr. Scobie settled down at Bournemouth, where the comparatively warm climate is an attraction for old Anglo-Indians, and his passing in the seventy-fourth year of his age will assuredly awaken many happy memories of him in the Coopers Hill Society to which he belonged. Of no man could it more confidently be said that he had not an enemy in the world.

Current News.

THE Pretoria Town Council has decided to order a 7,500 k.w. turbo-alternator.

THE total production of magnesite in India during 1926 created a record with 30,461 tons.

INDIA is to have an exhibit in Canada this year under the auspices of the Empire Marketing Board.

TWO plants for the distillation of oil from coal by the Dvorkovitz process are to be put up in Australia by the Rational Carbonisation Syndicate.

MR. NUR AHMED and Mr. Jogendra Chandra Guha have been elected Chairman and Vice-Chairman, respectively, of the Chittagong Municipality.

A MILL for rolling black sheets in Japan has been ordered, from the Tobata Casting Company by Mr. Etsujiro Nakayama. It will have an output of 15,000 tons a year.

A PIECE of land adjoining the Great West Road and the river Brent has been acquired by the Firestone Company of America for the establishment of a rubber tire factory.

RAI BAHADUR BADRIDAS GOENKA, M. L. C., is appointed a member of the Board of Trustees for the Improvement of Calcutta in place of Rai Bahadur Ram Deo Chokhani.

CLYDE shipbuilding yards have established a new record by producing 163,000 tons in the first quarter of this year. This is 20,000 tons better than the previous best quarter in 1925.

THE total approximate gross earnings of State railways up to 17th March amounted to 99·17 crores, or 449 lakhs more than the figures for the corresponding period of the previous year.

H. M. GOVERNMENT has appointed a Committee, consisting of members of the Ministry of Health, the Home Office, and the Medical Research Council, to inquire into the distribution of ethyl petrol.

ARRANGEMENTS have been made for the construction of an aluminium factory in Italy. The Haglund process is to be used. The name of the company is the Societa Italiano del Aluminio, Milan.

THE completion of the Avon dam has added 47,000 million gallons to the storage system of the Sydney water supply, so that the total is now nearly 100,000 million gallons. The daily consumption is about 65 million gallons.

THE total approximate gross earnings of State railways for the week ending 17th March amounted to 215 lakhs, 3 lakhs more than the figures for the last week and 4 lakhs more than the figures for the corresponding week of the previous year.

CONTRACTS have been awarded for a power development project of 65,000 h.-p. on the Back River, or Rivière des Prairies, seven miles from Montreal. The total value of the works, including dams and equipment, will be about 8,000,000 dollars.

AN interesting feature of the Machine Tool and Engineering Exhibition to be held at Olympia from 5th to 22nd September next will be a display of machines of historical interest, among which will be included a lathe made 120 years ago by the famous Henry Maudslay.

A CONTRACT has been received by W. T. Henley's Telegraph Works Company, Ltd., for a high-tension feeder in the form of underground cables and overhead lines to supply the towns of Saxmundham, Wickham Market, Melton, Oxford and Hollesley from the Ipswich mains.

AMONG the electric lighting schemes in contemplation, or recently put into operation in the State of Hyderabad, there is that at Aurangabad City, which has a capacity of 280 k.v.a. and is equipped with Mirrlees Diesel engines with Metrovick alternators. There are also schemes for Raichur, Warangal and Jalna, which, it is estimated, will cost at least 20 lakhs of rupees.

A NEW monthly publication of interest to all concerned in building construction and allied subjects will be placed on sale shortly by H. M. Stationery Office. Its purpose is to provide, for the building industry, up-to-date summaries of the latest developments in the science and practice of building which are taking place throughout the world. The price of the publication is to be 9*d.* monthly.

THE two double-cylinder 25,000-kilowatt turbo-generators needed for the Kirkstall station of the Leeds Corporation are to be supplied by the British Thomson-Houston Company, of Rugby. The machines are rated at 35,714 k.v.a. 10,500/11,500 volts, three-phase, 50-cycles, and the turbines are designed for a working steam pressure of 450 lb. per square inch gauge at 750 deg. Fah. temperature.

THE Marlborough (New Zealand) Power Board has, according to the "Industrial Australian," recently put into operation its hydro-electric power station at Benopai on the river Waihopai. The site permits of a development of 1,900 h.-p. and the plant installed includes two Francis type turbines, each driving a 500-k w. 6,600-volt alternator. Electricity is transmitted to Blenheim at a pressure of 33,000 volts.

INDIAN ENGINEERING.

Addresses and Changes of Addresses.

In requesting change of address give **old** as well as new address and write legibly.

The full and correct address should always be given on **Money-Order Coupons**—see instructions thereon.

NORTH WESTERN RAILWAY.

NOTICE.

SEALED TENDERS are invited for the supply of **Indian State Railway Standard Carriage Body Fittings** consisting of the following groups of items:—

- L. Body fittings including small forgings, castings and brass fittings.
- M. Panel plates and mouldings.
- N. Water tanks and necessary fittings.
- O. Dovetail floor sheets.
- P. Passenger Alarm communication fittings.
- Q. Bullion chest and dog box details.
- R. Lavatory fittings.
- S. Glass.
- T. Roof ventilators.
- U. India rubber details.
- V. Electric fittings.
- W. Trimmings including roofing canvas.
- X. Vacuum fittings.
- Y. Bolts and nuts.
- Z. Iron and brass wood screws.

These are required for the construction of *(i)* 33 sets of Bogie 3rd and Inter, *(ii)* 120 sets of Bogie 3rd class and *(iii)* 43 sets of Bogie 3rd, brake and luggage carriages. Tenders must be for one or more complete groups. Tenders for portions of a group will not be considered.

Deliveries must be in complete sets, each set comprising fittings for the construction of one vehicle.

The number of sets required to be delivered in each month is as follows:—

Material for {
9 complete sets of Bogie 3rd and Inter Class Carriages
30 complete sets of Bogie 3rd Class Carriages
11 complete sets of Bogie 3rd, Brake and Luggage Carriages
}

to be delivered by 1st July 1928. The balance must be delivered in 3 equal monthly instalments by 1st October 1928.

Tenders must be submitted on the prescribed forms which are obtainable from the Controller of Stores, North Western Railway, Headquarters Offices, Empress Road, Lahore, on payment of Rs. 5 per copy. Drawings for each group will be supplied at Re. 1 per copy.

Tenders must be addressed to the Agent, North Western Railway, Lahore, in sealed envelopes as provided and must reach his office not later than 2 P. M. on Tuesday, the 22nd May 1928.

The Agent of the North Western Railway reserves to himself the right to reject any or all of the Tenders received in answer to this advertisement without assigning any reason for such rejection.

CONTROLLER OF STORES.

Headquarters Office,
Dated LAHORE,
The *22nd March 1928.*

Foreign Notes.

Railways in Turkey.—Besides the Swedish, German and other foreign financial groups, a Turkish national group of 40 capitalists has been formed, according to a report from Constantinople, who have made an offer to the Turkish Government to build the railways between Turhal and Sivas and between Cesarea and Sivas respectively, the concessions for which two lines, according to an older report, had been obtained by a Franco-Belgian group, but been subsequently cancelled.

The Panama Canal.—According to a recent issue of the "Panama Canal Record," both the total number of commercial transits and the aggregate tolls collection created new record figures during the year ending 31st December 1927. The commercial transits, totalling 6,085, exceed by 610 the previous record of 5,475 transits during the fiscal year ending 30th June 1927, and the tolls exceed by 1,940,059·40 dollars the previous record of 24,290,963·54 dollars collected during the fiscal year ending 30th June 1924. It is of interest to note the total figures for the number of transits and tolls collected during the three calendar years 1925, 1926 and 1927, respectively, which were as follows:—4,774 transits and 21,380,759·70 dollars, 5,420 transits and 23,901,540·04 dollars and 6,085 transits and 26,231,022·94 dollars.

Prospecting by Electricity.—By means of a Swedish electrical prospecting method, large and valuable ore deposits have been located in Newfoundland, according to announcements made by Hans Lundberg, a Swedish engineer and the inventor of the method. It is said that rich copper, zinc and arsenic-lead finds were recently made in the province of Vesterbotten, in Sweden, by this means. The latest success reported is the finding of a deposit of approximately 3,000,000, tons of ore, containing 17 per cent. of zinc, 7 per cent. of lead, and 2 per cent. of copper near the Old Buchans Mine in Newfoundland, on territory belonging to three large mining concerns. The deposit is covered by 30 to 60 feet of boulders, but tests made by means of diamond drilling have shown that the new find is likely to prove very profitable.

Port of Casablanca.—The extensions which are continually being made to the port of Casablanca are justified by the growth of the phosphate industry as well as by the commercial and agricultural development that has followed the construction of railways with the idea of putting Casablanca into communication with the entire railway system of Morocco. The railways are to be electrified. Casablanca has now become one of the leading French ports. During the first half of 1927 the number of vessels entering it was 915, representing a gross tonnage of 1,923,218 and a net tonnage of 1,133,012. Of these totals French vessels accounted for 39 per cent. of the number and 53 per cent. of the net tonnage. The imports of coal increased from 77,243 tons in the first six months of 1926 to 112,096 tons in the first half of last year. There was also a much larger importation of railway material.

Abandonment of Peak Forest Tramway.—The London and North Eastern Railway has decided to abandon its Peak Forest tramway, and a keen controversy prevails in the Chapel-en-le-Frith neighbourhood as to whether or not the local authorities should purchase it and make a road in its place. It was one of the tramways that were built to supplement canals. The Peak Forest Canal lies between the Macclesfield and the Ashton canals and was sanctioned in 1794. A tramway was authorised by the same Act to run from the canal at a point which is now the Brigsworth Station of the L. M. S. Railway to Dove Holes. It is 6 miles in length and reaches an elevation 1,139 feet above Ordnance Datum. Part of the ascent is done by an inclined plane, 520 yards long, on a gradient of 1 in 8¼, with a short length near the top of 1 in 6¼. The line was laid out by Outram, who placed plate rails, 3 feet in length and weighing 56 lb. per yard, on stone sleepers. About 1,870 new rails were required, so the Manchester, Sheffield and Lincolnshire—which company acquired the canal and tramway in the 'forties—rolled new rails of the same section and weight, but 9 feet and 12 feet long, in the locomotive shops at Gorton.

Hydro-Electric Generating Plants in America.—According to the "Electrical West," thirty-three additions were made to hydro-electric generating plants throughout the eleven Western States of America in 1927 and 1928. Eleven of the plants are listed as having been completed in 1927 and twenty-two are now under way or are planned for construction at an early date. Three installations, notable as high-head plants, have static heads of 2,420 feet, 2,381 feet and 2,561 feet respectively. Six other plants having heads exceeding 500 feet are listed, but not all Western developments are in the high-head class, as several with heads below 50 feet are included, one of 3,000 h.-p. capacity being designed for a head of only 16 feet. The first propeller type runners to be installed in the West were put into service in 1927 at the Black Eagle plant in Montana and two notable automatic plants are listed in British Columbia rated at 12,500 and 17,500 h.-p. respectively. The largest units are double overhung impulse turbines to develop 56,000 h.-p. under a head (static) of 2,420 feet and a reaction unit of notable size and head is the 44,000 h.-p. turbine to be built this year for a head of 715 feet (static). Installations of less than 1,000 h.-p. are not included.

Causes of Fire in the Petroleum Industry.—In explaining the causes of fire in the petroleum industry to the Institution of Petroleum Technologists, Mr. C. Dalley said that, in the discharging of tankers, the period when there is greater risk is when oil is in motion, being actually loaded or discharged. This time should consequently be reduced to the minimum. The staff on board or in the vicinity of the vessel should be the minimum necessary to carry out the operation. Another example is that where ships maintain their own steam for discharging purposes, but all fires are "drawn" when loading. It is, he said, true that in the former case—discharging—fresh air is drawn into the tanks, whereas in loading, the expelled air is mixed with petroleum vapour, and consequently may be considered the more dangerous operation, although opinions are by no means unanimous in regard to the safety obtained thereby. In effect there is an added fire risk arising out of the precautionary measure. When the fires are "drawn" the flues, coated with soot to a certain extent, cool down. The soot is loosened and on relighting the fires a miniature pyrotechnic display often results, which may be a danger, not only to the tanker itself, but to other vessels or plant in the vicinity.

Cement Mixing Boxes: A New Idea.—A contractor for concrete construction, and who has to carry out a good deal of small work on which a mixer is unnecessary, had become tired of continually buying boards for the purpose of mixing his concrete, so he conceived the idea of having several large galvanised iron trays made with sides about 8 inches in height and measuring about 4 feet by 8 feet. These trays were not too heavy and could be easily lifted to and from the body of his small wagon and transported from one job to another with a minimum of labour. He also found that they saved him a considerable amount of cement as, under the old system of laying boards on the ground, a certain quantity of the cement in each mix was washed through the cracks between the boards when the water was put on the mix. These trays cost very little, and he considered they paid for themselves in a short time through the saving in cement and broken and rotting boards, to say nothing of the saving in labour putting down and taking up. It would appear that this type of box could also be used to advantage by bricklayers and plasterers who do the smaller class of work and who, under the system of wooden boxes which have to be taken apart to move from one job to another, damage or destroy enough planks in a year to far more than pay for the metal boxes.

New Union Station for Cincinnati.—According to the "Railway Gazette," considerable terminal improvements will shortly be effected in railway facilities in Cincinnati, Ohio, as the result of an agreement entered into between a railway terminal development company and the seven trunk lines entering the city. This agreement provides for a new union passenger terminal, with coach yards and an engine terminal. It does not include freight terminals, but improvements in freight facilities are already planned or being carried out by some of the individual companies. The cost of passenger terminal facilities is estimated at about 35 million dollars, while the several freight terminal works of the individual lines are expected to bring the grand total up to nearly 75 million dollars. The site proposed for the new union station is in Mill Creek Valley, adjacent to the business quarter. The present central station and its approaches are badly congested, while modern traffic conditions have far outgrown the original freight stations. The Pennsylvania Railroad does not use the present central station, but will enter the new union station, special arrangements being necessary for the purpose between the Pennsylvania and the Baltimore and Ohio companies. The Chesapeake and Ohio Railway is also at work on its new Ohio River bridge and approach lines, estimated to cost 12 million dollars.

New Engines for Rhodesia.—At the headquarters of the Rhodesian Railways the question of the number of additional locomotives which are likely to be required to deal with the anticipated increase in traffic during the latter half of next year has been having attention. Close calculating indicates that eighteen new locomotives will be wanted, and it has been decided that these new engines shall be of similar design to the twenty placed in service, *i. e.*, 12th Class "Mountain" type, with a 4-8-2 wheel arrangement. Certain minor moderations and additions will be introduced as a result of Rhodesian experience of that class of engine, though it is believed that the mechanical and transportation officers are very well satisfied with the results so far attained. The eighteen new locomotives are required to be in service at the latest by July of this year, and the order for their construction has been secured by the North British Locomotive Company, of Glasgow. Consideration is also being given to the purchase of more of the Garratt locomotives, which are giving such useful service on the heavily graded line between Umtali and Villa Machado in Portuguese East Africa. The large increases in passenger goods and mineral traffic—up to 30th June last more than 80,000 passengers had been carried in the first nine months of the financial year 1927 over those conveyed in the similar period of 1926, while the total earnings of the railways for the period show an increase of £592,000 over the corresponding period of the previous year—is causing difficulty in providing adequate rolling stock. The position will, however, be relieved soon by the arrival of new stock at present being built in England, which includes ten first-class coaches, six ordinary native coaches, and six composite third-class and native coaches. Four new dining cars are on order and are expected in Rhodesia at an early date.

Boiler Design for High Pressures.—It is generally recognised, says the "Railway Gazette," that with considerable rises of steam pressure in locomotive boilers, something very different to the present design of boiler will become necessary. Already it is becoming commonplace to regard 500 lb. per square inch as a figure which before long will have taken its place in the practical politics of locomotive boiler design, and much higher pressures than this are already being experimented with, although presumably it is not as yet sought to adapt them to everyday usage on railways. Such pressures as from 800 to 1,000 lb. per square inch would, presumably, make it necessary to depart altogether from the ordinary type of boiler with its staybolts, firetubes and other customary fittings, its place being taken by an all-watertube boiler, as has already been done in the field of stationary engine practice. With that as a basis, problems of design will arise in connection with the planning of the tubes to keep them free from bends, and therefore easily cleaned, and also in the general equipment of the boiler, with a view to improving combustion efficiency and replanning of the superheating apparatus. Rapid water circulation should be one of the attributes of such a boiler, and this would have a marked and beneficial effect upon the evaporative efficiency. The overall weight of such a boiler is likely to be greater than the present-day type, but owing to the fact that the weight of water carried would presumably be less as compared with a firetube boiler, this objection could be partially overcome. The first cost of a normal boiler is only about one-third of the total cost of a locomotive as a whole, so that the boiler first cost might be increased considerably without unreasonably advancing that of the locomotive itself, and if sufficient savings in operation and maintenance could be obtained, or if the ton-mile costs could be reduced through the building of more powerful locomotive units, then a more expensive boiler would be justified.

General Articles.

NOTE ON IRRIGATION IN BENGAL.

BY P. CLAXTON, A. M. I. E. (INDIA).

SIR WILLIAM WILLCOCKS in his Big Irrigation Schemes for Bengal, embodied in a lecture delivered at the British Indian Association Hall, emphasised the loss which Bengal suffered by being deprived of its rich red river water brought down by floods. To remedy this loss he advocates piercing the existing chain of embankments, at suitable points, notably opposite old channels, with numerous masonry works. These works would face the flood clean open, but might be regulated by needles if the flood were dangerously high. After seeing the effect of these measures, he further recommends the building of a barrage 7 miles below the Baral Head which will control the flood water of the Ganges, and insure a full flood every year so as to make inundations more effective.

2. The defects arising in Bengal, and their remedy, bring us back to Inundation Canal Practice which Sir William Willcocks proposes to apply in a much larger way. A larger way has also been forcing itself on us in the Punjab on the Indus Inundation Canals, and the two provinces have many points of common interest. The writer has studied inundation canal practice for years at Dera Ghazi Khan, and attracted by the problems in Bengal, ventured to outline a scheme combining Irrigation and River control. He has worked on that scheme and has recently read a paper entitled "Inundation Canal Practice" at the Punjab Engineering Congress held in February at Lahore. It may not therefore be out of place to show how the proposals may apply also to Bengal.

3. The proposals on the Indus, as those in Bengal, take their rise out of existing conditions. Utilising these conditions and natural features of the river, it is possible to work out a policy which may be very economical. At Dera Ghazi Khan the expense of carrying on a running fight at the river front has led us to realise that flood embankments, to be more permanent, should be aligned further back, that our canal should follow these embankments, that while one trunk canal is desirable, it should be fed from all the points of vantage from the river, and that supplies should be assisted and augmented by building groynes across the creeks. The virtue of this policy lies in the fact that it is a practical solution out of existing difficulties which may be introduced at small cost, and at the same time it will greatly reduce the expenses of maintenance for the future.

4. Presumably Bengal is faced with many of the same problems, and if Sir William Willcocks' proposals are to be given effect it may be worth while to recapitulate some of the leading features of the Congress Paper at some length.

5. Beginning with river behaviour, the paper dealt with the fact that silt is carried, not in one sustained effort, but by a series of leaps by the processes of scour and erosion. Erosion, the action at banks, in contradistinction to scour, the action over the bed, enters more largely into river problems in giving us excess loads which cause the river to meander. In meandering all rivers obey one law, *viz.*, they lay down shoals on the side at which erosion takes place. On this principle a diagram is reproduced which it is believed is true to principle. In this diagram there is erosion from A to B on the right side. At A the stream comes into the bank, having deposited its load of silt on *that side* in the shoal above. The water at A is therefore clear. From A to B erosion is active, and the load of silt increases all the way down, till at B the river is no longer able to carry it forward, and a shoal begins to form, diverting the stream across to C. From C the process, as at A, is repeated, only this time on the left side. The erosion from A to B is responsible for the shoal B, C, D, E, and the erosion from C to D for the next shoal on the left.

6. On this theory the favourable non-silting points for inundation canal heads can be determined, and occur at A, C, E and G. If possible the head is placed in the creek, a little higher up, for two reasons; the creek is subject to milder attacks and is more stable; and a groyne or dam may be built which is very desirable. It will be realised that by using creeks and pressing them into service by means of groynes we obtain ready made channels which it would not be possible to construct inland, except at great cost. In Dera Ghazi Khan canal heads are in this way being carried up at trifling cost for many miles, one vital principle being to work upstream for preservation. It is true that the head of the creek itself may not be situated at a favourable point on the river, but being higher up, and usually, for the time being, deeper and bigger in section than the canal itself, its service is invaluable. It in turn is also nearly always served by subsidiary heads which come to its assistance should one fail. Again, should the groyne collapse, the canal has an off-take from just above a clear point on the river and is able to carry on under favourable non-silting conditions from a back water.

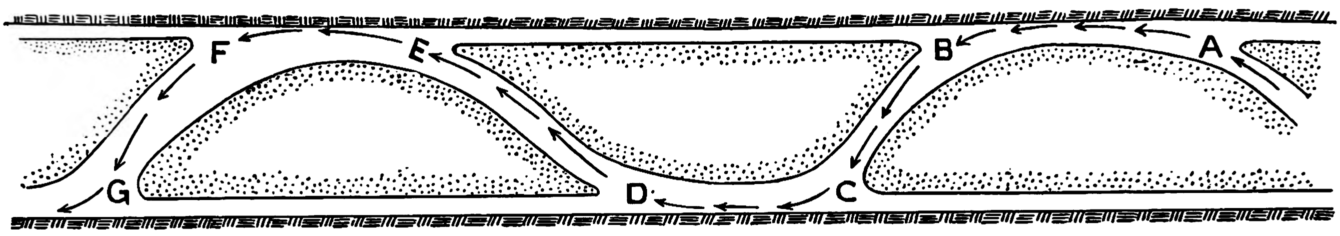
RIVER CONTROL.

7. Where no stone, or very little, is used, rivers can only be controlled by the still-water-pocket principle. This principle is illustrated at every Bell's Bund and need not be described here. Water to be held by earth embankments must be brought to a standstill, and this is effected by the still-water-pocket. Such a pocket is formed when a creek is completely closed. As this is not always possible, a compromise is effected by means of a groyne, which has only one flank closed by the bank of the canal or main high land, while the other is open. Whenever possible the nose of the open flank is carried on to a high shoal on an island or across the creek, working upstream at the same time to create a pocket. With experience many of these groynes are maintained through the floods, but whether maintained or not, they are powerful factors which, while they control river developments, give us early supplies and scour out low canal heads.

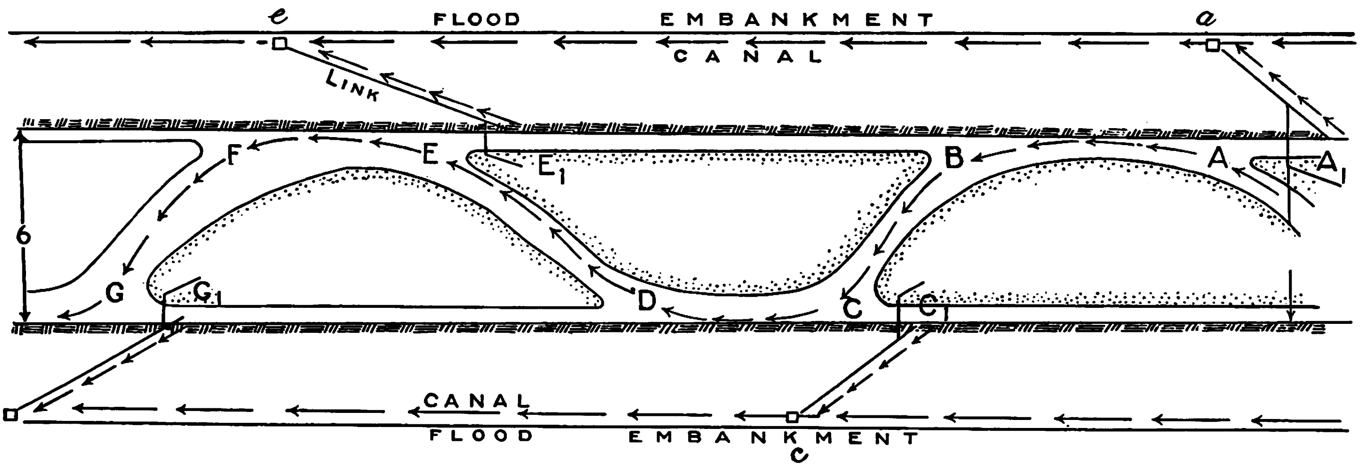
POLICY COMBINING RIVER BEHAVIOUR AND CONTROL.

8. Combining river behaviour and control, the writer, inspired by problems arising in Bengal, first worked out a policy for inundation canal heads in an article, entitled "Flood Administration and Control" which appeared in INDIAN ENGINEERING, Nos. 4, 11, 18, 25, July 1925. The leading principles of this policy are illustrated in diagram 2. After further experience on the Indus canals, he can offer it with greater confidence.

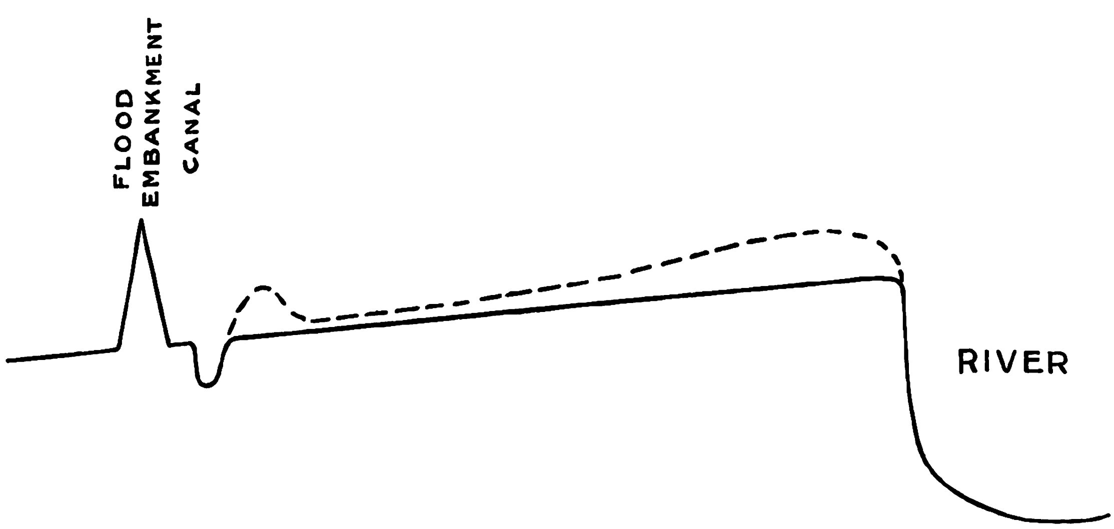
9. The usual form of river is shown by the meandering course A, B, C, D, E, F, G, within the normal flood embankments which of course will not be so regular, but will be more or less constant, marking the limits within which the river may wander. Beyond these limits the flood embankments and main lines of canal should be built as at a e and c g. One of the features of the policy was the combination of the canal and flood embankment by aligning the canal along the borrowpits of the embankment on the river side. Thus the cost would be that of the embankment only. The canal would have no river bank but would spill over the whole river front. It, itself, would remain clear, since it would be the deepest channel which would form naturally along the embankment, even without the help of borrowpits. On the river edge it would have a high margin of spill which would keep it from returning to the river. The cross section at the time of construction would be as shown by the diagram, Fig. 3, and in time with successive deposits of silt, this would tend to grow into that shown by dotted lines.



TYPICAL DIAGRAM OF RIVER



TYPICAL DIAGRAM
SHOWING
FLOOD ADMINISTRATION & CONTROL



SECTIONAL DIAGRAM
SHOWING
EFFECT OF CONTROL

NOTE ON IRRIGATION IN BENGAL.

10. This trunk canal would run the whole length of the district, more or less constant in capacity. It would feed other branches off-taking at the points a, e, c, g, etc. The trunk canal itself would be fed by links, run in from points just above each of the favourable points A, C, E, G, as described above. They would be at an angle, so as to form pockets with the trunk canal, at the junction with which regulators and escapes would be built. These points would also be the heads of the branches. Each link would be under entire control at the junctions a, e, c and g, a regulator into the next compartment, and a head of a branch canal, being built at each point. By means of any of these regulators the flow in the compartment above a link would be brought under entire control, even to the extent of causing the link to work back to the river by heading up. This control would regulate silt deposits in the upper compartment to some extent. These compartments by arresting silt would grow valuable for *rabi* irrigation, while behind the embankment, *kharif* crops would be sown. The system would be unique in making all the heads on the river available for service. The trunk canal also would be impregnable, *i. e.*, it would be impossible for river erosion to sever it. Such action frequently ruins an inundation canal. Here, however, should erosion threaten to eat into the canal, it would also threaten the embankment; and as this must at all times be maintained for the preservation of the district, it would have to be built further back as a loop, and the canal would automatically follow it. Not only would existing favourable points of the river be made available, but short cuts to others might at any time be made along with other links. The canal, as a trunk canal, could make up shortages at one off-take with excess at another, thus making the supply more even. The large compartments would also act as dampers and would neutralise temporary shortages. Thus this plan provides for every difficulty with which an inundation canal is faced. It aims at affording a steady, even, and assured summer supply.

11. The above description will, of itself, have made the application of this policy to problems in Bengal more clear. Bengal already has its flood embankments which have to be pierced, as advocated by Sir William Willcocks. The points at which regulators are required will correspond to points a c e g of diagram 2. To be effective in obtaining the early and late supplies they will have leading in cuts, as Heads, A_1a C_1c E_1e and G_1g. Groynes in the creeks will greatly assist and make the system more perfect. Beyond the points a c e g, on the land side, Sir William Willcocks proposes to build short leading in canals which will distribute the supply in veritable inundations over the country. Such a scheme may thus be readily and cheaply harnessed. On the Indus canals nothing cheaper can be had, and at the same time nothing more effective.

12. Coming to the question of a barrage, it will be realised that groynes in themselves will create local flood conditions at each canal head which may even be as effective as a barrage. It should be remembered that the point of intake is by them transferred higher up to the head of the creek and the comparatively larger supplies of the creek are headed up in the vicinity of the groyne, and are forced down comparatively narrow Heads Aa, Cc, Ee, Gg, at high velocity, scouring out and maintaining low beds. Thus raised supply and low Heads are created, both of which give us the augmented supplies which Sir William Willcocks seeks. It is of course not always possible to hold a groyne throughout the floods, but before it breaches, it has secured the early supplies and has done much useful work besides. A breach does not usually occur too early, and by that time the bed has been scoured out low, and the Head is able to carry on to the end of the season. By being linked as a Trunk canal failures at one or two points are made good from other points which remain intact.

13. By groynes, a great deal of land on the river side is also reclaimed. Not only are richer supplies of red silt diverted and redistributed inland, but a large amount is also arrested in the creeks and distributed on the river side of the embankments. These deposits may not yield *kharif* crops, but are valuable for the *rabi*. Thus groynes not only raise the supply but divert and arrest the maximum amount of red silt from the river.

14. In the matter of river control, groynes, by choking off side creeks, help to keep the river from developing down them, and so check its lateral swing. So long as they are needed for canal heads the policy of consistently building them must be borne in mind. River control which is otherwise a side issue, even though a very important one, is therefore automatically cared for.

15. An objection is frequently raised that groynes choke off the feeding creeks on which the canal depends, and so tend to defeat their own ends. On a river which is constantly changing such a danger is never really present. The changes not only offer as many new heads as may be affected, but side creeks are not readily choked, but diminish in section, so long as the off-take is good they may continue to work as canalised channels for years.

16. Again, it is not believed that groynes can survive floods when water at such a time escapes freely round the open flank. Engineers usually forget that water levels above and below the groynes at such times tend to become one, and velocity round the nose is damped down and largely ceases to be a danger. For this reason groynes can and do escape.

17. In conclusion, Sir William Willcocks has done great service in focussing attention on to the benefits of basin irrigation by inundation canals, and his recommendations are bound to receive attention. Yet ways and means of carrying out his proposals are to be found. Flood embankments exist and have simply to be pierced, but behind that operation lies the whole of Inundation Canal Practice. What are the best points at which openings should be made, how will they be fed from the river, what are the best points on the river from which they may be fed, how can supplies be improved so as to be made available earlier and last longer, how may flood conditions be assured, and how may the maximum of red silt be drawn in and distributed over the land? These are some of the questions which arise and which are answered in the above remarks. They are not given haphazard but are the experience of years, and developments arising out of similar conditions in the Punjab are being applied. If they assist problems in Bengal the writer will be repaid for the trouble of writing these notes.

RAILS AND TYRES.

"The Metallurgist," Supplement to "The Engineer," of January last, writes that the rail problem and, perhaps in a slightly lesser degree, the tyre problem, has always been with us since railways began to grow and develop. To-day it is of greater importance than ever, not only because technical conditions—heavier loads and higher speeds—impose more strenuous conditions on both wheels and rails, but also because economic conditions, including the competition of the road vehicle, make the profitable working of the railways an increasingly difficult problem. The life of rails and tyres, in relation to their cost both as to material used and the labour of replacement—is an important factor in railway economics, and is thus of interest, not only to those concerned with the railways themselves, but to all those affected by the satisfactory and economical working of the railways.

It is almost obvious at the outset that the use of heavier axle loads and of higher speeds demands the use of harder material, if only from the view-point of actual surface indentation. That actual indentation under wheel loads must be amply avoided is clearly

necessary, since otherwise the rapid destruction of the surface layers of material by excessive cold-working and subsequent cracking must follow. Actually, while perceptible, permanent indentation under wheel loads probably never occurs in normal service, there are occasions when special conditions lead to very severe local loading of both rail and tyre, as, for instance, by the sudden application of brakes leading to skidding of the wheel. The destructive effects of such loading, especially in connection with the formation of transverse fissures, has been extensively studied in France.

The natural tendency towards the use of harder steels has been followed extensively in practice. Some twenty years ago a steel rail with a carbon content of 0·25 per cent. was regarded as normal, and fears were expressed that the use of higher carbon steel, although furnishing a harder rail and one likely to be more durable, might prove dangerous on account of the much reduced ductility. The experience of recent years has failed to confirm entirely either the favourable or the unfavourable anticipations in regard to rails made of harder steel. They have not proved unduly brittle or dangerous on account of their lower ductility, but, on the other hand, their greater hardness has not resulted in a corresponding diminution of the rate of wear. This latter fact has led to extensive investigations, mainly carried out abroad, on methods of testing the abrasion resistance of steel. Finality in methods of testing for this purpose has not yet been attained, and different types of abrasion test still yield results which are not entirely comparable. All agree in showing, however, that hardness as measured by indentation tests, and therefore tensile strength, is not a measure of wear-resisting quality. As yet it is not possible to state to what other physical properties of steel this power of resisting abrasion is related, and we have either to be content with empirical test data for comparison or have to resort to the slower method of testing various types of steel in service in order to arrive at a basis of selection.

Meanwhile, steel metallurgists have not been idle, and much has been done towards the improvement of the wear-resisting quality of rail steel by heat treatment. This has been applied according to several somewhat different methods, which all aim at providing the rail with a hardened wearing surface without converting the entire section into hardened and relatively brittle material. It must, however, be admitted that here also finality has not yet been reached. Progress is rendered difficult, from the metallurgical point of view, by the strict limitation of cost which is applied to material which has to be employed in such large quantities as rail steel. The use of alloy steels is for that reason almost ruled out, unless they could be shown to have a more than proportionately longer life. Even in regard to the simple carbon steels, however, the question of cost as affecting quality is important. Sound steel, free from both pipes and blow-holes, and of good chemical composition, undeniably costs more than a "rimming" or blown steel of lower purity. If, however, special heat treatment is at all worth while, attention to the quality of the steel to be treated is fully as important. To heat treat a poor quality rail is simple waste of time and money and leads only to the discrediting of the heat-treatment method. It is true that the soundest steel is proof neither against rapid wear under adverse conditions, nor apparently exempt from transverse fissuring, but its resistance can be materially improved by heat treatment. The same treatment applied to unsound steel can never overcome the inherent defects of the material, and may even—by the formation of cracks—intensify them.

The tyre problem, although intimately bound up with that of the rail, is not quite so difficult. The tonnage of steel concerned is not nearly so large and the question of cost of the steel not so prohibitive. Even in tyres, however, alloy steels are not, as yet, very widely used, and reliance is placed on high-carbon steel. Here, however, attention is seriously given to the quality of the steel as regards soundness, chemical composition and segregation. The modern method of rolling tyres from cheese-like sections of ingots or billets, instead of from the old beehive ingots, has eliminated some serious risks of unsuspected unsoundness. On the other hand, cracking still sometimes occurs as the result of the stress produced when the tyre is "shrunk on" to the wheel. This convenient method of attachment is, in fact, open to serious criticism from this point of view. The stresses which are imposed upon the tyre as the result of shrinking on are sometimes serious, and become superimposed on the severe working stresses set up under service conditions. These stresses, however, although they may lead to fracture, presumably do not affect the wear resistance of the tyre. The latter may perhaps be regarded as reasonably satisfactory at the present time, but if the wear resistance of rails is increased, it must imply increased wear on the tyres, unless the quality of these is proportionately improved. At present the tyre is much harder than the rail, and the rail is worn away. If the conditions of hardness are reversed, then it is the tyre that would probably take the wear. Here the use of special heat-treated alloy steels may prove to be necessary, but again the question of abrasion testing arises. It is, indeed, only when we can readily determine the wear-resisting properties of our materials that we shall be in a position to discover, without the need of long and costly service trials, better materials for these special purposes. This is surely a matter of primary importance to the railways. Abroad it is chiefly the railway laboratories that are occupying themselves with the difficult problem of abrasion testing. Are our railways, directly or indirectly, making any efforts in that direction? The user of material generally expects the manufacturer to carry out research and to initiate progress. In the present instance, however, the gain from progress will be entirely with the user—the railways. Increased resistance to wear, provided without any great additional cost, will entail for the steel maker, at all events no increase of output, while to the railway it will be a matter of great financial advantage and even of economic necessity. It would seem to be a case where at least a great part of the onus of providing for progress should fall directly upon the user—the railways.

HYDRAULIC PROBLEMS.

In the previous three articles on "Factorization," the three on the "Kennedy Formula," and two on the "Pyramid Kennedy Formula," an attempt is made to define the conditions under which the new formula must be worked and used, to trace the causes of the defects in the "Kennedy" Formulas, and to give some proofs of the P. K. Formula which will ensure general acceptance.

The advantages of factorization cannot be better shown than by expanding table A (Factorization) in the same manner as the little table inserted at the beginning of article II (P. K. F).

d	f_p	m_p	x	V_o Ken.	V_o P. K.
3	2·500	2·500	30	1·697	1·823
4	"	3·333	"	2·040	2·105
5	"	4·167	"	2·353	2·353
6	"	5·000	"	2·644	2·577
7	"	5·833	"	2·918	2·784

Assuming that $V_o = 0{\cdot}84\ d^{\cdot 64}$ for section No. 3 ($d = 5$), then $C_o = 1{\cdot}153$ (log ·061710). *Any*-V_o^{1} : *any*-V_o^{11} :: $\sqrt{d^{1}}$: $\sqrt{d^{11}}$, in the P. K. V_o, simply because all the sections possess one and the same f_p. Again *any*-m_p : *any*-d :: *any*-m_p^{1} : d^{1}, in the table.

Suppose now, Kennedy's formula is written $V_0 = Xm_p^{.64}$, the values of X are respectively from 0·94406 to 0·94384, or practically a constant. A very slight variation in the index 0·64 would make X constant. It seems to be correct, therefore, to declare a properly devised "Kennedy" formula, to be an empiric formula adjusted to any uniformly arranged standardised sections in a well-thought-out Canal System; and in this consideration lies Mr. Kennedy's claim to perpetual fame. There can be little doubt but that, had he been in a position to carry investigation further, and abandon empiricism, he would most probably have rediscovered the Pyramid Kennedy Formula years before the writer commenced the present task.

If a vertical line, or something similar in the nature of a curve, be taken to represent the Pyramid Kennedy Formula x-values, then the corresponding Kennedy Formula is a line (or curve) inclined to the vertical. The respective straight lines, indeed, might be taken as tangents to the two curves at a common point of curve intersection. And it is more than probable that the same remarks might apply with the necessary factorization to the Pyramid Tangent Formula, $v = c \tan \theta$, when compared with either of the Barnes' two formulæ, or Kutter's Formula. Much, of course, would depend upon the graphs being drawn with quantities or with logs.

It is possible indeed that the equation:—

$$f_p = \frac{3(x+5)}{x+12}$$

is only one of many similar equations, each applying to one series of channels in the same conditions of flow, and that each locality may require for accurate V_0 an appropriate series of f_0, rather than V_0 based on f_p.

With reference to the figure inserted in article I of the "Kennedy Formula" articles; the writer feels that much regarding the construction remains to be discovered. He is strongly of opinion that the ancient engineers used two Y-units, and thereby brought all hydraulic problems on to a standard parabola for universal solution in one settled way. This standard parabola makes AS = 1, AN* = 16, and SL = 2, when the solution of each problem in hydraulic flow would be a matter of simple arithmetic based upon a few accurate observations, and the deduced constants.

Readers of INDIAN ENGINEERING will no doubt be much interested in Mr. K. O. Ghaleb's comments upon the "Factorized Hydraulic Formulæ" articles of 1925, and made in Vol. 223 of the Civil Engineers. It is a great matter that the ancient Egyptian theory can be applied to modern Egyptian practice.

Regarding the Kennedy sections the writer repeats that he sees no reason whatever for doubting the accuracy of observation of the sections as being all rectangular, or nearly so. It is a matter about which no engineer, of Mr. Kennedy's calibre, could be mistaken. But it is quite possible there were errors in v, due to causes beyond Mr. Kennedy's control: withdrawal of water in transit for irrigation, and so on. And the fixing of the formula at $0·84\, d^{.64}$ is a clear proof that unconsciously he "averaged" x. At any rate the way seems open now for still more correct results in V_0.

The writer has done his best to indicate the weak as well as the strong points in the P. K. theory. The doubt regarding a constant C_0 is due to lack of scientific and accurate data. The fortunate observers who can first deal with such data, hold the solution in their hands. The writer is content to wait and watch; but he does hope the finder will publish his results in INDIAN ENGINEERING, in fairness both to the writer and the paper, who both have borne the heat and burden of the day. It seems almost incredible that in a narrow channel eight feet deep with bed-width a little over 14 feet, V_0 should be, say 2·618 feet per second; while with the same depth and bed-width nearly 119 feet, the safe V_0, in like conditions of flow, should be 3·179 feet per second. The writer instinctively feels this to be true; but it is the expert canal engineer who has the last word.

Finally, without in any sense detracting from the great work done by Irrigation Departments all over the World; the evil of waterlogging has assumed such proportions that it threatens to destroy the very areas irrigated by the emasculation of populations by malaria, or the rendering barren of rich soils by swamp or efflorescence. The remedies are: to check percolation and similar losses, and to use the absolute minimum of water in the actual irrigation. These remedies have been known for centuries; the delay in their systematic application is not so easy to understand. It is thought that, in India, if percolation and similar losses could be reduced by half, and if by more frequent and lighter and more rapidly absorbed waterings the quantities of water supplied to fields could be reduced by one-third, that waterlogging would lose its terrors. All existing canals, with the saving in "cusecs" indicated, might then be silted to reduced sections and rendered, at the same time, watertight. The recovery of waterlogged lands might be slow, the process extending over many years, but it would be sure and permanent.

The LAW OF THE P. K. EQUATION can now be stated.

If the velocity of flow in any earthen channel is also a critical mean velocity and can be stated in the form of the equation: $V_0 = C_0\sqrt{m_p}$. Then the outline of the section of channel, measured and defined by the said hydraulic mean radius m_p (the factor C_0 being a constant throughout) is a stable outline, which during the continuance of the said V_0 will neither scour nor contract by deposit of silt, in the same continued conditions of flow. In other words the same interpretations made of the Kennedy formulæ apply also to the P. K.

This closes the whole series of ten articles, including the Preface and this Summary. *Ziyadah hadd adab.*

Σ. Φ.

9th January 1928.

* Can AN be intended to indicate ½ g?

THE RESTORATION OF THE ANCIENT IRRIGATION OF BENGAL.

BY SIR WILLIAM WILLCOCKS, K. C. M. G.

A lecture delivered at the British Indian Association Hall, Calcutta, on the 6th March 1928.

(Continued from page 180.)

25. The country, supported by the Bengal National Chamber of Commerce,* is strongly opposed to the construction of an alternative steamer canal continued athwart the whole of Central Bengal. I criticise it as an hydraulic expert. The proposed "*closed* Grand *Canal*," which is estimated to cost £2,300,000, is the first link in the long chain. It is some 30 or 40 miles long and 400 feet wide. If carried out it will stereotype the serious mistakes made in Calcutta in the past and prevent the suburbs of Calcutta and the 24-Perganahs north and south of it from escaping from the poverty and malaria of to-day. The worst mistake in the past was the making of a *closed* navigation canal from the Hooghly eastwards. A *closed* canal is a canal which is not allowed to be crossed by any waterway. This one obstructed every irrigation canal for 30 miles east of Calcutta and blocked it. It not only blocked the forward movement of all surface water but of all subsoil water. This stagnation of subsoil water renders a canal which cuts across subsoil flow a far greater menace to health and fertility of soil than a wrongly placed bank. This navigation canal also cut off some 150 square miles of basin of the Bidyadhari tidal creek down which is taken the drainage of Calcutta and into which flows

* Vol. I, No. 2 of the Journal of the Bengal National Chamber of Commerce.

Tolly's nala with its head in the Hooghly. The proposed closed Grand Canal, 400 feet wide, would have stereotyped all the surface obstruction, and, by its width and depth, aggravated many times over the subsoil obstruction. Every thinking man in Calcutta has opposed it root and branch. The cutting off of 150 square miles of the Bidyadhari creek set in motion the deterioration of the creek and created difficulties for the drainage of Calcutta. These difficulties were greatly aggravated by the recent construction of big spurs in the Bidyadhari creek and the practical closing of Tolly's nala by the construction of a sluice; and now the Corporation of Calcutta is in very great straits for the drainage of the city. To improve the position of the drainage of Calcutta and to sweep clean that grubby and malaria driven mess called the northern and eastern suburbs of Calcutta the solution is one and the same. Abolish the navigation canal, remove at once the wrongly placed spurs and the deposit between them in the Bidyadhari, and remove also the obstruction in Tolly's nala. Put back everything where it was before the closed canal was made, and the able drainage Engineer of the Corporation, who has studied this question for six years, will fill in every detail in the scheme. Open up every irrigation canal of 60 years ago and put decent bridges under the railway going north of Calcutta, and continue the canals through bhil and land, irrigating and blessing and washing out stagnant pools and filthy marshes. But let all these filthy accumulations of water be first cleared of water-hyacinth. The navigation canal for boats will do no harm to Calcutta if taken along some natural flow like the Ichapur and Nowi canals past Harwaganj to Kulti. Calcutta will be free of its dark and messy navigation canal which looks like Styx or Acheron when you cross it. It might be filled in and made a long playground for the boys and girls of the poor quarters it traverses.

26. We now turn to the existing steamer route whose deterioration at its western end has been precipitated by the recent interference with the flow of the tidal creeks at this end. All this interference is connected with the Diamond Harbour drainage scheme by which the Diamond Harbour tidal creek was closed and a big regulator put up in its stead to serve some 200,000 acres of land. The existing steamer route of some 230 miles in length is a series of narrow and broad creeks and reaches of canals between the Hooghly and the Ganges-Brahmaputra. Along this whole length the expenditure on dredging in the last 10 years has been roughly £2,500 per annum at the western end; while towards the eastern end in the parts which are a portion of the proposed alternative canal there has been during the last 10 years an expenditure of £2,500 per annum at one point and £15,000 per annum at another. Compared with these together the expenditure at the western end is trifling.

27. The recent interference at the western end has resulted in a change in the direction of the tides and these are adjusting themselves in the channels to their new conditions. With intelligent observation and skilful dredging a capable engineer should soon be able to establish a permanent channel and keep it open. We engineers exist to carry out such work. The alleged difficulty of finding an earthen bank on which to deposit the silt is no difficulty. It can be settled by the purchase of a few barges to carry the silt to suitable spots and drop it there. They do this in other places where dredging is carried out. It helps moreover to check the quantity of work, which little else can do. The interference going on with the tidal creeks could be greatly lessened if every drop of sweet water in the river in flood were allowed to enter the drainage basin, which could enter. At present it is one ten-thousandth part of what it was. Remove the sluice recently built at the head of the Kaorapukur canal. Every sluice in the Diamond Harbour regulator should be fully open every day of the flood and not the ordinary one or two. The zemindari banks should be provided with wide sluices or left alone. Little minim sluices are very harmful to the existing steamer route. I may add that the keeping out of the rich red water of the flood is undoing the good done to the crops by the keeping out of the salt water. The great increase of malaria since the carrying out of the work would have a chance of being brought back to normal if fresh river water were allowed to enter freely.

27A. The demand for an expensive alternative steamer canal under such conditions as we have here can only be compared to the action of the boy who killed his father and mother and then pleaded for special treatment as an orphan. And moreover what guarantee is there that in this long chain of very numerous links, none of which are independent of works carried out in their vicinity, another difficulty may not arise elsewhere? It is true engineering to solve the difficulty before us on its own ground. Its solution will show the way to solve others which may arise.

27B. The statement made that without these steamers Calcutta would be unable to get the products she needs will not hold water. Central Bengal is already traversed by four lines of railway to bring produce from the east and the north. They are capable of supplying every need, and, if necessary, the Faridpur line can be extended southwards with numerous openings. And then there are the ordinary boats, big and small, which are the glory of Bengal as they are of Egypt. They could be increased tenfold if necessary. These boats are to-day greatly handicapped by the huge paddle wheel steamers each towing two huge barges and between paddle wash and tail wash in the narrow channels making it hard for all small craft. The steamers should be strong tugs dragging barges at a moderate speed, in consideration of the small craft. This is what they are in Egypt. Boats and boatmen are worth protecting, for they do their work in the face of every difficulty, and never ask for any consideration. We say in Egypt that the only men whom the first Viceroy Mahamat Ali never subjugated were the boatmen. With tugs hawling barges at a moderate speed (in the way they do in Egypt) through the narrow passages of the 230-mile track, it might be possible to let sailing boats use the track as well along its whole length. In this case the navigation line mentioned in paragraph 25 would not be necessary.

(To be continued.)

The Gazettes.

Punjab, March 30, 1928.

Buildings and Roads Branch.

The leave on average pay for one month, with effect from 24th February 1928, granted to Mr. G. E. J. Haegert, Assistant Secretary to Government, Punjab, Public Works Department, Buildings and Roads Branch, is extended by 7 days on average pay.

Mr. Hukam Singh, who has been appointed a Temporary Assistant Engineer, reported his arrival in the Fourth Circle on 3rd March 1928, and was attached to the office of the Executive Engineer, Multan Provincial Division.

Hydro-Electric Branch.

The Apprentice Engineers in the Punjab Public Works Department, Hydro-Electric Branch, noted below are holders of the posts declared by the Punjab Government (Ministry of Agriculture) to be gazetted posts with effect from 1st March 1928:—Mr. Zain-ud-ud-Din Ahmad, Mr. N. C. Gupta, Mr. T. N. Idnani, Mr. F. H. F. Manikshaw, Mr. S. Z. Malik, Mr. K. C. Gandhi, Mr. M. N. Ahmad, Mr. M. A. Ghafoor, and Mr. Fazal Ellahi Khan.

Mr. A. S. Corrigan, Additional Assistant Secretary, Punjab, Public Works Department, Hydro-Electric Branch, is granted leave on average pay for two months, with effect from 9th April 1928.

On return from the Government of India, Department of Commerce, which he left on 14th March 1928, Mr. K. G. Mitchell, Executive Engineer, joined and took over charge of the Administration Circle of Superintendence, Public Works Department, Punjab, Hydro-Electric Branch, on 21st March 1928, from Mr. W. N. McLeod, who proceeded on leave.

Rai Sahib Lala Shiv Shankar, who has been appointed a "Civil Officer," joined the "C" (Construction) Circle of the Public Works Department, Punjab, Hydro-Electric Branch, on 25th July 1927, and assumed charge of his duties on 29th July 1927.

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INDIAN ENGINEERING.

SATURDAY, APRIL 14, 1928.

ENGINEERING IN MYSORE.

THE last bulletin of the Mysore Engineers' Association notices the opening ceremonies of the Gorur Bridge, the Kankanhalli Transformer and Switching Station, and the Nanjangud-Chamarajnagar Railway. The Gorur Bridge provides for carrying the Hassan-Periapatna road across the Hemavati River. In the past, during low water the ferry and ford were used for passenger and cart traffic, but in the rainy months the crossing of the river was impracticable and the inconvenience so caused was considerable. The new bridge meets a decided want. It is of stone masonry, and consists of thirteen arches of 30 feet span each. The waterway provides for passing a maximum flood of 100,000 cubic feet per second. The cost of the work was Rs. 1½ lakhs. The Kankanhalli Station was designed for four functions, it will receive 40,000 electrical horse-power from Sivasamudram at 75,000 volts and distribute it to the Kolar Gold Fields, Bangalore, Channapatna and Kankanhalli and vicinity; it will transform the power for Bangalore and Channapatna from 75,000 to 37,500 volts; it will transform the power for Kankanhalli and vicinity from either 75,000 or 37,500 volts to 2,300 volts; and it will receive the power at either 75,000 or 37,500 volts from Mekadatu, when the generating station at that place is constructed, and feed it into the stream of power coming in from Sivasamudram for distribution to the several centres of consumption. It was mentioned at the ceremony how the Bangalore power supply had grown in ten years. In 1915-16 the gross revenue of the Bangalore section was Rs. 2,90,000, derived from 2,433 street lights, 1,977 light consumers, and 50 power consumers, who together consumed 6,176,719 units of power. In 1925-26 the revenue rose to Rs. 12,76,500, derived from 3,124 street lights, 7,094 light consumers, and 234 power consumers, who consumed 26,517,330 units of power. There has been an average annual increment during this ten-year period of 33 per cent., and it represents the extent to which electricity enters into the daily life of the people. The newly opened railway runs for a distance of 22·29 miles from Nanjangud to Chamarajnagar, both places of some importance. In between are rich irrigated lands, plantain groves and cocoanut gardens. The railway has a ruling gradient of 1 in 100, and the sharpest curve is of 995 feet radius. There are seventy-four culverts and bridges, the largest bridge being that which crosses the Gundal River by a 30 feet high girder bridge of four spans of 40 feet, its cost was Rs. 75,000. The deepest cutting is 1,500 feet long and 25 feet deep. The cost of the railway was Rs. 12 lakhs. The bulletin gives the following papers read at the 19th Session: "Testing Suspension-type line Insulators" by Mr. G. Yoganandan, "Notes of Experiments on the

effect of Mechanical Agitation in bringing about Subsidence in Coagulation Tank" by Mr. K. S. Venkataramanan, B. A., B. E., and "A Note on the Maximum Flood Discharge in the Cauvery at Krishnarajasagara Dam at 2 P. M. on 26th July 1924" by Mr. B. Krishnaswamy Iyengar, L. C. E.

MINES IN INDIA.

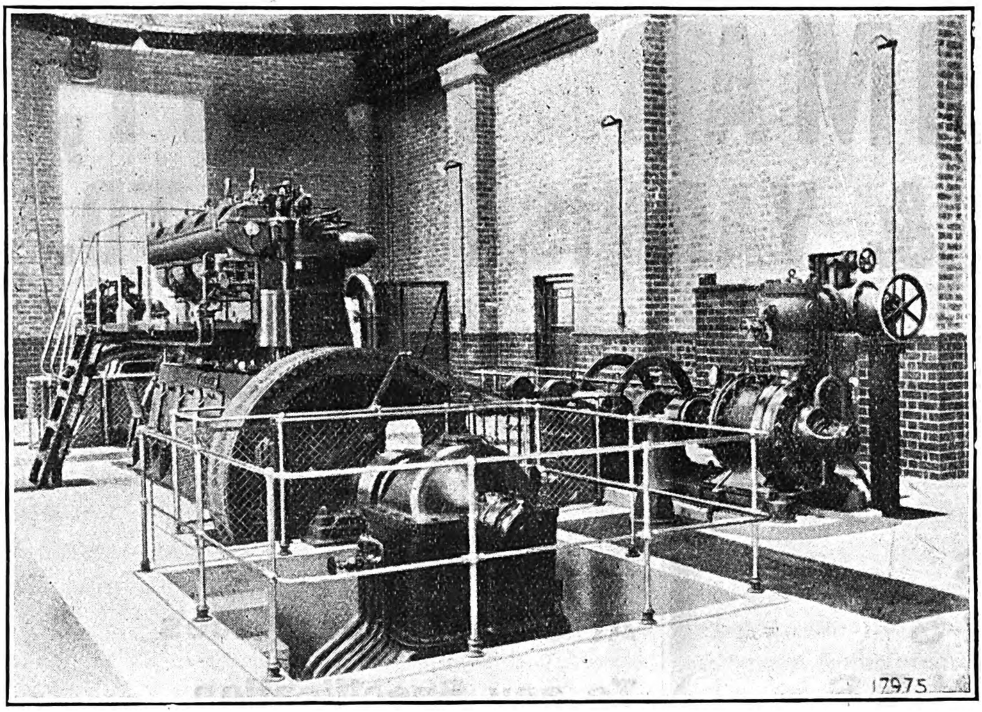
THE last annual report of the Chief Inspector of Mines in India is that for the year ended 31st December 1926. The total output of coal in 1926 was 20,093,024 tons, an increase of 123,983 tons over the output of the previous year. Of the above total, the Bihar and Orissa figure was 13,942,404 tons, and Bengal comes next with 5,137,688 tons. Bengal showed an increase of over 200,000 tons, the less important coal provinces showed decreases, the year was one in which prices fell steadily and many mines producing the poorer qualities of coal had to close down. In such a year the Raniganj coalfield has the advantage that its position is favourable for the market and the quality of coal is good. The exports showed a considerable increase, owing in some measure to the coal strike in England, and for the first time in history India sent coal (48,868 tons) to the United Kingdom. A favourable factor in the situation was the increased reputation of Indian coal in export markets by reason of the supervision and certification of cargoes by the Indian Coal Grading Board. The number of collieries using electric power is on the increase and the value of coal-cutting machines is becoming more recognised. The number of persons employed in coal mines was 170,628, a lower figure than that of 1925, though in Bihar and Orissa and Bengal the labour was generally sufficient for the requirements. The output per person employed above and below ground was highest in Bengal and Bihar at 122 tons, the corresponding figure in Great Britain, where the mines are deeper, being 221 tons.

The production of iron ore in 1926 was 600,363 tons, an increase of 13·41 per cent. over the production of 1925. The output of manganese ore, 857,099 tons, showed an increase of 20·66 per cent. The greater part of the manganese ore now being mined is obtained from open workings, though in course of time underground operations may be the rule. The Bawdwin mine of the Northern Shan States in Burma produced 362,505 tons of lead-silver ores, an increase of 12·79 per cent. The production was 53,273 tons of refined lead, 1,057 tons of antimonial lead, and 5,103,646 ounces of refined silver. In addition 11,441 tons of copper matte and 48,834 tons of zinc concentrates were produced for shipment. The output of gold increased from 288 ounces in 1925 to 1,053 ounces in 1926. The continued high price of tin led to activity especially in the Mergui district of Burma and the output was 2,568 tons. The production of wolfram was 751 tons. The output of chromite ore decreased, it was 16,455 tons against 21,236 tons in 1925. The Indian Copper Corporation, Limited, continued to develop its mines at Mosaboni in the Singhbhum district, and the ore reserves are said to exceed half a million tons and to contain more than 21,000 tons of copper. The value of the gems, rubies, sapphires and spinels, handled at the Burma Ruby Mines in 1926, is given at Rs. 4,66,772. A rich pocket of sapphires was found at Kyaungdwin in the Kathe valley. The production of mica, 41,451 cwt., decreased by 8·66 per cent. The output of rock-salt was 122,801 tons, and that of limestone 827,222 tons. From the fifty-one stone mines from which figures were obtained, 414,573 tons of igneous rock, 229,962 tons of unspecified rock, 45,289 tons of laterite, 18,502 tons of sandstone and 748,868 tons of gravel were produced. From the twenty-three clay mines, from which figures were available, 89,065 tons of fireclay, 15,926 tons of china-clay and 16,458 tons of ordinary clay were produced. There were increases in the production of steatite, asbestos, ochre, kyanite and corundum; and decreases in the production of magnesite, bauxite, slate, barytes, apatite and fuller's earth. Small quantities of garnet and crude beryl were mined.

INDIAN RAILWAYS, 1926-27.

THE report by the Railway Board on the railways of India in the financial year 1926-27 shows the year to have been a satisfactory one. It was not a record year, the somewhat defective monsoon of the previous year did not lead to any very optimistic anticipations, and during the early months of the year concerned the receipts were such as to indicate that the reserve would have to be drawn on in order to meet the obligation to pay the annual contribution to central revenues. But the monsoon of 1926, though late, gave well-distributed rain and improved the conditions. In Burma and on the East Coast rain was excessive and caused serious interruptions in the traffic, but generally speaking the traffic in the last months in the year was good, and this with a reduction in working expenses enabled the railways to meet the contribution obligation and to add a substantial sum to the reserve. The total receipts amounted to Rs. 1,00,12,37,000 and the total expenditure to Rs. 92,62,71,000. The net gain was therefore about Rs. 7·50 crores, of which a little over Rs. 6 crores were appropriated to general revenues and the balance transferred to the reserve. The return on the capital-at-charge of the State-owned lines was 5·05 per cent., the returns of the five years ending with 1925-26 being 2·64, 4·38, 5·24, 5·85 and 5·31 per cent. These percentages are calculated on the capital-at-charge of both commercial and strategic railways, the latter being unremunerative. The route mileage open for traffic was 39,049, the number of passenger-miles 20,366,250,000, and the number of ton-miles 20,374,679,000.

The total additions to the mileage during the year were 421, and several new lines were commenced, including the Kangra Valley Railway. The opening of the broad-gauge connexion between Parbatipore and Siliguri, after conversion from metre gauge, effected a long-desired improvement in the rail connexion between Calcutta and Darjeeling. Regarding future



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additional mileage an important phase was the programme arrived at for the addition of over 7,000 miles to the railway system of India during the five years ending in March 1932, with about 4,000 miles under construction at the end of the period. The fulfilment of this programme is subject to the various projects, as they are examined in detail, showing on the estimates a probability of adequate financial returns, and subject also to the possibility of provision of the necessary funds by the Legislature. The formulation of this programme is said to have been greatly facilitated by certain decisions of the Railway Board on the standard of construction to be adopted in varying circumstances, and an outstanding event has been the issue of new rules for the designs of bridges with important changes in the method of calculations for moving loads. It is not to be expected that every one of the new projects will prove after survey and estimating to be worth constructing, but there appears to be no reason why, out of the 7,000 miles, an annual addition of 1,000 miles should not be realised. It is interesting to note that the long-vexed question of low-grade railways has received careful attention. There are places where cheap railways are required for the benefit of the agriculturist, such as those in connexion with great irrigation schemes. Every increase in the cultivation implies increase in the produce to be carried to market and difficulties of transport in tracts where there is an insufficiency of reasonably good roads. The purpose would be best served by railways, by cheap and slow branch lines without break of gauge, and the report says that the Railway Board have now laid down standards of construction ranging from the highest class which has to carry a fast and heavy traffic to the lightest form of construction. This is action which was much needed, and with the different standards it should now be possible to choose one which will suit the traffic to be expected and to yield a fair return in almost every case, unless the nature of the country precludes the construction of an inexpensive railway, or there are special reasons rendering it impossible for any railway to compete successfully with road traffic. As in other countries, railways in India are beginning to feel the pressure of road motor competition, and the report says that the general policy adopted by railway administrations is to meet such competition by endeavouring to afford the public equal or better railway service than road transport can give, while taking full advantage of the additional traffic brought to the railways by such motor transport as can act as feeders or distributors. It is, however, fairly obvious that more than that form of general policy will be needed, and this appears to be recognised. The East Indian Railway has introduced an experimental rail-omnibus, consisting of a bogie third-class carriage and a small engine, the purpose of which is to serve short-distance traffic by picking up and setting down passengers at level-crossings, tickets being issued on the train by a conductor. On other railways, similar experiments have been made, and in some cases it has been found necessary to replace the rail-omnibus by a full length train to meet the development of traffic. Experiments have also been in progress with self-propelled coaches, such as the "Sentinel," and it is satisfactory to learn that the problem of finding the most suitable power unit for this class of work continues to engage attention. In November 1926 a new standard of travel was instituted by the commencement of the improved weekly service between Bombay and Calcutta in connexion with the inward and outward English mail, and the train has been called the "Imperial Indian Mail." It provides sleeping accommodation and a dining car, and the journey can now be accomplished in great comfort.

In matters of administration, the Standing Committee of Chief Engineers of Class I Railways has been abolished, but the Sub-Committees functioning under the Standing Committee have been retained under the direct control of the Railway Board. These Committees are now designated the Track Standards Committee, the Bridge Standards Committee and the Signal and Interlocking Standards Committee. The Railway Board has a declared policy of establishing and maintaining standard designs and specifications for all technical equipment on Indian railways. The standards are adopted on the State-managed railways, and in certain cases are prescribed for the Company-managed railways also. The most important questions dealt with by the Track Committee under the new arrangement were the preparation of standard designs of points and crossings and cast-iron and steel sleepers for the 5 feet 6-inch gauge railways. The Bridge Committee appears to have done specially good work in respect of the allowance to be made for the impact effect of a moving load running over a girder at high speed, the effect of which has been that many existing girders, which would have required renewal under the old rules, can be kept in use; that some existing girders, over which the speed of trains has been restricted in the past, will be permitted to take the same train-loads without restriction of speed in future; and that in other cases greater loads than were permissible under the old rules will be permitted to run at unrestricted speeds over existing girders. This means, moreover, that all new girders will be lighter and therefore cheaper. The same Committee has further by inspection of workshops of important bridge girder building firms led to improvements in the standard of workmanship. The Signals and Interlocking Committee has dealt with the revision of the existing rules for the design and inspection of signalling and interlocking, the framing of rules for electrically-operated and power-operated points, and the framing of rules and regulations for the installation, maintenance and working of single-line and double-line block instruments. The Railway Board's report for 1926-27 is altogether a very good one, it gives very lucidly all the salient facts of the year's operations, with some excellent illustrations in the way of plates, and all the necessary statistics of the working of a very large and important organisation.

AMERICAN BUILDINGS.

THE talk of the distinguished American architect, Mr. Harvey Wiley Corbett, F. A. I. A., before the Royal Institute of British Architects in London, was an interesting occasion. Mr. Corbett took for his text "The Latest American Building Methods," and he said that in America, unhampered as they were by tradition, a new country free to move in almost any direction that commerce and habits of life dictate, they were developing something of world interest. They had a new form of cons truction, previous methods had gone, the skeleton construction of steel had come in, and made possible very rapid building and the piling up of storeys to great heights. Speed and steel were the two most important factors of present American architecture. As far as that goes, there is nothing particularly novel in it, and it is very doubtful whether it is correct to say that in the matter of architecture America is unhampered by tradition. America is not as new as all that. If a country were suddenly to become civilised in the twentieth century, it might possibly be entitled to say that it had no traditions and was not going to have any. But if a country have no traditions, architecture has traditions, a past to draw inspirations from, and America has that just as much as any other coun try. And she knows it very well; Washington, for instance, was built when America was younger than she is now, and at Washington tradition was not disregarded. Man may once have lived in caves, then in mud structures or in wood, and wood gave way in course of time to brick or stone, as brick and stone are now giving way in towns to reinforced concrete or steel as a skeleton encased in other ways. But as soon as there was anything to call architecture, architecture evolved, and there was tradition. It is known what Roman architecture owed to Gre ek, and Greek to earlier art, how the Renaissance harked back to Classic precedent, and how art has alwa ys been influenced by what went before it. And Ame rican architects paid as much respect to evolution in design as architects elsewhere.

What Mr. Corbett really meant was something different, and he referred to something which if not entirely new is a matter of quite a short time ago. He said that in the past buildings had been erected to last almost indefinitely, they have lasted centuries, but in America there has been lately the new idea that a building is designed for a specific purpose and for a specific time, and that its life should be limited to its usefulness for that purpose. It is not known exactly what the life in durability of an American skyscraper is, it depends so much on the protection of the steel, or if not adequately protected it will corrode; but that is not of much consequence if in the American hustle and bustle and the desire to have everything new and up to date a building is not required to last long. Some years ago, not so very many, there was surprise in other countries than America because a sixteen-storey steel framework building in New York was being pulled down. It was the first of the sky-scrapers to be demolished, and fifteen years previously it had been regarded as one of the wonders of New York. But it was not demolished because it was going to fail, it was just that a new building of twice the height was wanted. In large and busy cities, where land is of immense cost, there will always be a tendency to construct tall buildings for economical reasons, but Mr. Corbett said that skyscrapers are not the result of want of lateral room to expand, the total quantity of building on Manhattan Island to-day is not more than the total quantity of building in the centre of London covering a similar area. It is more that tall buildings are required for the exigencies of the rapid conduct of business. For certain types of business accommoda-tion space in a concentrated form is important, and skyscrapers are demanded from considerations of a practical nature. From that American point of view there is nothing more to be said; in motor cars, as Mr. Corbett remarked, improvements are made, old cars are scrapped for the newest thing, and the same idea is now being applied to buildings. A sixteen-storey building being out of date, it is better to demolish it for one of fifty storeys or as may be. It is nothing apparently to America to take down a building after twenty years or so and replace it by another more suited to the time. But then America for the last half a dozen years has been so abundantly prosperous that she can afford to play that game. The original skyscraper, Mr. Corbett says, may have been started through the necessity of some property owner to exploit that particular locality to the greatest possible extent. Not having any restriction placed on him in regard to height, he could go as high as he wished. But exploitation would not continue; that in itself is never successful. There is a fundamental economic reason for the city's growth, and the economic reason is expressed by the greater efficiency in business which is secured through these concentrated zones of sky-scrapers.

That being said from the business aspect, it has to be admitted that foreign as the skyscraper is to preconceived ideas of architecture the soaring build-ings of New York are conspicuously good in design. They express for one thing the material of which they are built, in fact they could be built in no other way, and built in that way they have a beauty and a dignity of their own. The old cornice has disappeared entirely, it served no practical purpose in structures of this kind. It is the vertical accent which is appropriately emphasised. The works are so designed that the material can be machine-made. The machine is used as a basis of design, and in a machine age the buildings are characteristic of the time. The beautiful monuments of the old world were constructed with the aid of a slave population or forced labour. America has an obedient slave in the machine, and she aims at using the machine to relieve humanity of the burden of labour.

Notes and Comments.

A Proposed New Dam.—Work is soon to be undertaken on a dam near Hohenwarte in south-western Germany for the purpose of harnessing the falling waters of the River Saale. The dam is to be 250 feet high and will impound 6,700,000,000 cubic feet of water that will have a head varying between 90 and 220 feet.

Berai Canal Scheme.—This is a project for the irrigation of 9,000 acres of paddy in the Bankura district. The length of the canal will be about 35 miles and the system will be equipped with a weir at the head across the Berai river to turn the water into the canal. The scheme is estimated to cost Rs. 5,25,000.

Railway Accounts.—Mr. Hayman of the Railway Board has curtailed his leave as he has been deputed to examine the Dickenson report regarding the reorganisation of Railway accounts. He will take up the special duty in time to enable him to prepare the case for presentation to the Standing Finance Committee for Railways before the Assembly meets for the autumn session.

A New Rail Route.—A direct rail route from the deepwater harbour at Stewart, British Columbia, to the Yukon Territory, Alaska, has been planned by Canadian enterprise for the purpose of developing northern British Columbia, particularly the Atlin District. The length of the proposed road is about 500 miles, and it would connect at Carcross with the White Pass and Yukon Railway.

Assam-Bengal Railway.—The new metre-gauge railway line sanctioned by this Railway between Chittagong and Nazirahat (21 miles) is under construction. Materials have been collected for the construction of the proposed line from Chittagong to Dohazari (26 miles) at a cost of about Rs. 52 lakhs. The latter line will ultimately connect Chittagong with Burma by further extensions southwards across the river Sanko.

Railway Transport.—On Class I Railways during the week ended 24th March 1928, 88,956 wagons were loaded on the broad gauge (7,765 more than in the corresponding week of 1927) and 59,729 on the metre gauge (7,200 more than in the corresponding week of 1927). From April 1927 to 24th March 1928, 304,388 wagons more were loaded on the broad gauge and 92,373 more on the metre gauge than in the corresponding period of last year.

British Indian Engineering Stores.—On another page will be found the advertisement of this firm who deal in Surveying, Drawing, Mathematical Instruments and Drawing Office requisites. The firm has issued a very complete catalogue of these goods of which they hold a very large stock and sell at very reasonable prices. A copy of this catalogue may be obtained by applying to the office of the firm, 47, Radha Bazar Street, Calcutta.

Bakreswar Canal Scheme.—Considerable progress has been made by the Government in connection with this scheme designed to irrigate 10,000 acres of paddy from the Bakreswar river in the district of Birbhum. The total length of the canal will be 25 miles of which about 5 miles have already been dug and materials are being collected on the silt for a weir, the construction of which will be taken up next cold season. The work is estimated to cost about Rs. 5,00,000.

Calcutta Improvement Trust.—This Trust has made considerable progress with the schemes which it has undertaken, and has in contemplation more big schemes to improve the City, amongst them :—(1) A main road 100 feet wide to connect Park Circus with Store Road, Ballygunge. (2) Improvement of Burra Bazar to cure sanitary defects and traffic congestion; this latter of an experimental nature. The entire neighbourhood north of Dhakuria Lake may, in the course of a few years, be developed for residential purposes.

Floating Dock for Airplanes.—The world's first was launched a short while ago at a shipyard in Lubeck, Germany. The dock has a supporting capacity of 1,000 tons, which is considerably in excess of the needs of the largest seaplanes now operated by the German "Lufthansa," the heaviest of these flying machines weighs only 23 tons. The structure is designed not only to facilitate the company's airplane traffic but is also to be used in connection with experiments looking towards transatlantic service.

Takoradi Harbour.—This harbour on the Gold Coast was formally opened by Mr. J. H. Thomas on the 3rd instant. It provides the only complete shelter for vessels drawing over 30 feet on the 1,300 miles of rough coast between Nigeria and Sierra Leone. Inland communications having developed considerably it became an obvious necessity to improve methods of shipping produce which hitherto was conveyed in surf boats, often through extremely heavy seas, to anchorages two miles from the shore. The construction of the harbour, which constitutes a brilliant engineering feat, has cost the Gold Coast £400,000 and covers 200 acres.

Upkeep Cost of Motor Vehicles.—The difference in the cost running over improved and unimproved roads has been made the subject of study by various highway departments. The results, as reported by the American Automobile Association, show that the operating cost of all types of cars is 25 per cent. lower when those cars used hard-surfaced instead of dirt roads. In the case of gravel roads as compared with dirt roads the difference amounts to 10 per cent., and is in favour of the gravel road. These revelations are being turned to good account by the Bureau of Public Roads in determining what highways shall be given preference in deciding on improvements.

Indian Railway Construction.—The new mileage opened and the amounts spent in new construction during the last eight years are as follows :—1919-20, 200 miles, 59 crores of rupees; 1920-21, 365 miles, 1·34 crores; 1921-22, 268 miles and 2·56 crores; 1922-23, 382 miles and 3·58 crores; 1923-24, 430 miles and 2·70 crores; 1924-25, 233 miles and 2·75 crores; 1925-26, 352 miles and 4·38 crores; and 1926-27, 338 miles and 6·47 crores (Budget lines only). It is expected that about 900 new miles will be opened in 1927-28, and it is hoped to maintain this figure during the following two years. A sum of about 7½ crores has been provided in the Indian Budget for expenditure on new lines during 1927-28. The above information was obtained by Lord Winterton, at the request of Major Glyn, M. P.

Staff Changes, B.-N. R.—Mr. S. H. Medcalf, Assistant Engineer (Isolation), Manharpur, took over charge from Mr. A. K. Tikku, Assistant Engineer (Isolation), Gidni, in addition to his own Subdivision, from 31st March 1928, and Mr. Tikku on relief proceeded on leave. Mr. N. H. Daniel, District Engineer, having been granted an extension of leave by one month, Mr. A. E. Stringer handed over charge of Bilaspur District on 15th March 1928 to Mr. W. B. Harben, Subdivisional Officer, who will hold charge of the District in addition to his own duties until relieved by Mr. Daniel. Mr. J. C. G. Baillie relieved Mr. G. W. Manson as Personal Assistant to the Superintendent, Carriage and Wagon Branch, from 20th March 1928 and the latter officer took up his duties as Assistant Loco. Superintendent, Khargpur, on 21st March 1928.

Indian States Commission.—At a banquet in honour of the Indian States Committee at Bhopal, the Nawab said the crux of the situation was that the paramount power should in fairness and justice, see that both political and financial rights of Indian States were maintained, the paramount power safeguarding and preserving the interests of the States and people just as much as those of the people of British India. Regarding the Simon Commission he said the policy of the States was one of good faith and co-operation. Sir Harcourt Butler, in reply, assured the Nawab that the Committee would approach the question with the utmost sympathy and good-will: they would always keep in view what an important part of the Empire the Indian States formed. In the House of Commons Earl Winterton said it was understood that certain ruling Princes would unofficially visit England in the summer to take legal opinion regarding the evidence which they desire to submit before the Committee. Such matters, being still *sub judice*, would not be discussed by the Princes with the India Office or the Imperial Government.

New E. I. Railway Locomotives.—Fourteen new passenger locomotives have been added to the East Indian Railway's rolling stock. These were assembled at the locomotive sheds at Lucknow. These new engines displace those formerly running on the express services, and have been built to the design of the Locomotive Standing Committee by the Vulcan Foundry Company, Limited, Newton-Le-Willows, Lancashire. The axle load is only 17 tons, but the E. I. Railway have engines under construction at the moment with an axle load of 19½ tons. These will be ready by July. A similar type of engine for goods traffic is now on the way from England. This will enable heavy loads to be carried over sections like Jhajha and Gomoh without the assistance of a banking engine. The new express passenger engines have fully come up to expectations both as regards power and smooth running. Special attention has been given to the springing of the engines, and rubber springs have been fitted, thus ensuring easy running. The weight of the engine and tender in working order is 155 tons. Ten tons of coal can be carried in the tender and 4,500 gallons of water. The new engines have a grate area of 45 square feet as compared with 32 square feet in the case of the engines which have been displaced.

Sind Requirements.—Presenting the report of the Karachi Chamber of Commerce for the year 1927, the Chairman, Mr. F. Clayton, had some interesting remarks to offer connected with expected developments. He thought the demand of Karachi for the broad-gauge connection with the United Provinces was fully justified. Another urgent necessity was feeder lines, in view of the fact that the Sukkur Barrage scheme was nearing completion. The undertaking would lose the greater part of its value unless the question of communications and transport received unremitting attention. Government interest in their requirements was not lacking and the Oderalal-Mehrabpur connection had already been sanctioned. The question of roads was of great importance. A source of complaint was the paucity of visits from members of the Viceroy's Council. Personal acquaintance would create a lasting interest in India's third port. If the political position of Sind was not realised and protected, the old question of separation of Sind would become a live issue. A readjustment of portfolios was due and ought to include the creation of a Minister for Sind.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 28th March 1928 :—Messrs. Stewarts and Lloyds, Ltd., Calcutta—700 running feet tubes, 10 inches steel casing, 19 to 21 feet long, Rs. 7,525 free on rails Dalowali by 17th August 1928; Messrs. The Bengal Iron Co., Ltd., Calcutta—130 pipes, cast iron, double flanged, 8 inches, Rs. 4,230 f. o. r. Kulti; 500 pipes, spigot and plain socket joints, 8-inch bore, Rs. 14,700 f. o. r. Kulti; Messrs. The AEG India Electric Co., Ltd., Bombay—lot electric power aerial distribution lines, material for, Rs. 1,06,925 free delivery at railway station Lyallpur including erection by 30th September 1928, except transformers; Messrs. Martin and Co., Calcutta—18 spares, for 300 Ruston dragline excavator, Rs. 1,027 c. i. f. Karachi; Messrs. The Lightfoot Refrigeration Co., Ltd., Calcutta—1 lot plant, acetylene generator, complete with fittings, Rs. 3,014 f. o. r. Howrah; Messrs. Turner, Hoare and Co., Ltd., Bombay—1 pair driving wheels, for Aveling and Porter's steam road rollers, Rs. 3,570 free delivery at Mhow.

Daring American Tunnel Construction.—Because of its novel and daring construction features, world-wide attention has been focussed on the tunnel which is being built beneath the estuary that divides Oaklands and Alamedia in California and which will be opened early in May. This tunnel, which is 4,436 feet long, is built mainly of pre-cast concrete cylinders, the walls of which are 2 feet 6 inches thick and are 37 feet in diameter and 203 feet long. The cylinders were constructed some ten miles from the actual site and were floated and towed down the river—no mean feat of navigation considering the cylinders weighed 5,000 tons each and drew 26 feet of water as they floated. The roadway is constructed 7 feet 5 inches above the lowest point of the cylinders and allows for two side walks each 3 feet 5 inches wide, elevated above the road level and protected by hand rails, whilst the carriageway has a width of 22 feet 10 inches between the kerbs. A concrete ceiling has been erected across the cylinders 7 feet

5 inches from the top and the two spaces thus provided at the top and bottom of the tunnel provide the ventilation ducts. Fresh air under pressure is pumped into the bottom space and is driven by fans up into the main part of the tunnel through air flues. In the ceiling of the tunnel are exhaust ports through which the vitiated air is drawn by suction. The subway, estimated to cost some £899,200, is being built as a public highway and will be a free road.

The Milan-Munich Air Line.—Although the distance from Milan to Munich is only 225 miles, the journey by air is probably one of the most difficult, but at the same time picturesque, in Europe. The Avio Linee Italiane S. A. of Rome will shortly open this air line with a fleet of Armstrong Siddeley Lynx engined Fokkers. Milan is only 900 feet above sea level, and, as some of the Alps are over 12,000 feet high, machines going north have only a few miles over the Italian plains in which to gain height. The run south is not quite so severe because Munich is 3,000 feet above sea level and the mountains do not rise as abruptly as on the southern side. Immediately after leaving Milan the machine passes over Monza, the famous motor racing track, and a moment or two later the easterly leg of Lake Como comes into sight. In front rise the majestic barriers of the Berganese Alps topped by Mount Redorta nearly 10,000 feet high. The town of Sondrio is an easily found landmark with the river, road and railway jostling each other down a narrow valley running east and west. Snow-clad pinnacles and fields of jagged rock now give place to the pasture of the valleys and the journey progresses over the Bernina Pass that joins St. Moritz with Tirano. A few minutes later the stately Ortler, nearly 12,000 feet high, is seen gleaming white, with a trail of green pastureland to its west, indicating the approach of the highest motor road in Europe. Green valleys and snow-clad mountains follow each other in rapid succession, but gradually the country seems to take on a less cruel and jagged appearance. The mountains drop away towards the Bavarian border, and the last 20 miles further to Munich, the journey's end, is comparatively tame.

Tyres.—A correspondent of "Modern Transport" makes some very useful remarks on the tyre factor in motor transport and the penalties of neglect, remarks that apply to solid tyres as well as to those of pneumatic and "cushion" type, though generally speaking we may be more concerned with the modern tyres of the day. Among the great improvements made in motor vehicles of recent times, are those which affect tyres, and that is shown by the increased efficiency in mileage and the greater comfort and conveniences. But, as the writer says, the tyre mileage is affected by various new factors in connexion with roads and vehicles. The camber of the roads, the speedier acceleration of vehicles, the increased efficiency of braking and the developments in body design have a distinct bearing on tyre use and service, and unless they are studied in relation to tyres, it is tolerably certain that users are going to be faced with rather extraordinary instances of reduced mileage from the better tyres of to-day. The writer, not without reason, calls the tyre the Cinderella of the equipment, other matters receive attention but the tyre is very commonly neglected. However well made tyres may be in the first instance, the service they render is almost wholly in the hands of the user, and if the user ignores questions of inflation, overloading and hitting the kerb or hitting something else, he must be prepared for a reduction in the potential life of tyres and not blame the manufacturer. The tyre is a very vital detail of the equipment, that is obvious enough as it is an essential thing that cannot be dispensed with. In the case of a motor coach fleet, which should operate with the regularity and reliability of a main line train service, every hold up through tyre trouble means loss of revenue. But on all counts every owner of a car will desire long life for his tyres and freedom from tyre trouble, and the article gives valuable advice.

Cholistan Railway in Bahawalpur State.—The first 40 miles of the Bahawalnagar-Cholistan Branch Railway was opened by His Highness the Nawab of Bahawalpur State before a distinguished assembly at Bahawalnagar on the 3rd April 1928. After the Chief Minister of Bahawalpur State, Nawab Maula Bakhsh, had asked permission to open the Durbar, Colonel Walton, Agent, North Western Railway, delivered an address, in which he said that this branch line has been financed by the Government of His Highness of Bahawalpur State, construction and working being in the hands of the North Western Railway. Actual construction was commenced in January 1927. The whole length of 63 miles to the dry bed of the Hakra River would be completed in another 3 or 4 months, well within the estimated figure of about 40 lakhs. The Agent acknowledged with gratitude the ungrudging assistance given to the railway engineers by the State officials, irrigation engineers on canal construction and other officers in such matters as land acquisition and water supplies. The Agent expressed a hope that perennial irrigation and railway communication associated with good administration would bring prosperity to the State. His Highness then unlocked the gates across the new line with a silver key and formally declared the railway open. He said the camel would now have to make way for the locomotive and he hoped before long to see the Cholistan converted into a Gulistan, a land of dust into a land of flowers. "I can see with my mind's eye thousands of settlers pouring into the colony, with teams of cattle in the wide fields and pastures, and hamlets and towns springing up as if by magic on either side of the railway line. Thousands of wagons full of corn and cotton being driven to the nearest market or railway station will before long become a common sight." The 63 miles of railway would afford transport, commercial and travelling facilities, without which the blessings of perennial irrigation could not be fully enjoyed by intending colonists. His Highness expressed appreciation of the good services rendered by Messrs. Dale-Green, Bond and Cruickshank of the North Western Railway in the construction of the line and congratulated the administration on having *kept the cost well within the estimate.* In conclusion His Highness expressed his gratitude to Mr. Fitzpatrick, Agent, Governor-General, who, in his former capacity of Revenue and Public Works Minister of Bahawalpur State Government, was responsible for all arrangements which had made it possible for the Railway Department to complete the section now opened in such a short space of time.

Current News.

MR. MCWATTERS, officiating Industries Member, arrived at Simla on 11th April.

MR. R. J. HILL, Executive Engineer, North Western Railway, is permitted to retire.

A RAILWAY survey on the metre gauge, from Rutlam to Galiakot, is sanctioned.

SOME £55,000 is to be expended on the water supply scheme for Witbank, South Africa.

A GRAIN elevator of 2,000,000 bushels capacity is to be erected at Collingwood, Ontario, at a cost of about 900,000 dollars.

IT is probable that two more 10,000-kw. generating sets will be added shortly to the power plant of the Johannesburg Corporation.

THE Traffic Board's inquiry into the claim for protection of the petroleum industry in India will be opened in Rangoon on 24th April.

MR. CLOW, Secretary, Industries Department, leaves Delhi to-day, halts at Dhanbad for two days and returns to Simla on 20th April.

NO. 2 Construction Subdivision of the Salin Canal Division, P. W. D., Burma, Irrigation Branch, was constituted on 15th February 1928.

HATTERSLEY Tunnel at Mottram, in the Manchester district of the London and North Eastern Railway, is in process of being opened out.

THE Prince of Wales will visit Bristol on 23rd May to open the eastern arm extension of the Royal Edward Dock. The new dock has cost about £1,000,000.

RECONSTRUCTED, St. Nicholas Bridge, at Carlisle, which has cost £68,000, was opened by the Mayor, Mr. Joseph Henderson, who is a railway shunter.

IT is said that the agricultural produce which accumulates at Paichun, the terminus of a new branch from the Chinese Eastern Railway, amounts to 500,000 tons a year.

THE total approximate gross earnings of State Railways up to 24th March amounted to Rs. 101·42 crores, or Rs. 463 lakhs more than the figures for the corresponding period of the previous year.

A WIRELESS telephone company has just been founded in Budapest for the purpose of installing receiving sets on the trains of the Hungarian State Railways and also in the waiting rooms at the big stations.

ACCORDING to Mr. H. A. Curtis, the Chief Engineer and General Manager of the Hydro-Electric Department of Tasmania, the State possesses available water power to the extent of 1,750,000 horse-power.

ELECTRIC trains which no passenger is allowed to board are running from London Bridge, Cannon Street and Charing Cross to Tattenham Corner and Purley daily, stopping at stations as they will do when the service is opened.

THE total approximate gross earnings of State Railways for the week ending 24th March amounted to Rs. 215 lakhs, the same as last week, but Rs. 4 lakhs more than the figures for the corresponding week of the previous year.

AT a recent meeting of the board of directors of the South Manchuria Railway Company, it was decided to appropriate 1,500,000 dollars (about £150,000) for the erection of a large observatory at Tahoshangshan, Kinchow, in the leased territory of Kwantung.

FIVE deep tube-wells sunk by the Bhadhakali Co-operative Anti-Malaria Society (four with the grant of Kumar Bhupendra Nath Mukerjee of Uttarpara and one at public cost) were formally opened on Sunday last by Mr. A. W. Cook, Commissioner of the Burdwan Division.

IT is announced that a contract to build 150 miles of railway for the Turkish Government, involving a total expenditure of nearly sixty million dollars, has been secured by America. The contract includes the construction of breakwaters, piers and modern docking and loading facilities at the ports of Mersina on the Mediterranean and Samsun on the Black Sea.

THE Railway Board have sanctioned a preliminary survey being carried out by the agency of the Assam-Bengal Railway Administration for a line of railway on the 3 feet 3⅜-inch gauge from Gouripore to Mankachar with a branch from Bangoan to Jamalpur, a distance of about 100 miles. The survey will be known as the Gouripur-Mankachar Railway Survey.

A HIGHWAY bridge, which, according to the "Engineering News-Record," is believed to hold the record for height above the valley crossed, has recently been built across the Snake River Canyon in Southern Idaho, about 3 miles north of the city of Twin Falls. The roadway is 476 feet above ordinary water level and 502 feet above the stream bed. The bridge consists of two structural steel towers, supporting a central cantilever span of 700 feet and two 225 feet anchor arms.

Literary Notices.

Locomotive Management from Cleaning to Driving.—By Jas. T. Hodgson, M. I. Mech. E., and the late John Williams. London: The Railway Engineer, 33, Tothill Street, Westminster, S. W. 1, 8½ ins. × 5½ ins. × 1 in., 449 pp., 57 half-tone illustrations and 229 line drawings. Price, 5*s*. net.

The sixth edition of this handbook on the management of locomotives has been revised and brought thoroughly up-to-date. As its title indicates, this work is a manual intended for the use of the engine driver and the aspirant to that position, and it will be found also of considerable assistance to members of the running shed and shop staffs whose duties bring them into daily contact with the locomotive engine. Every detail of the locomotive is illustrated and described in the book, while in addition there are special chapters devoted to the various regulations affecting the movement of engines and trains in traffic, signalling, etc., with which it is necessary that the engineman should be thoroughly conversant both for purposes of passing the prescribed examinations for promotion and also in the course of his daily work. The chapters consisting of questions and answers on the locomotive, break-downs, brakes and rules are so arranged that a study of their pages will materially assist the engineman in obtaining a thorough grasp of these matters. The book contains a large number of locomotive illustrations prepared from official photographs and the tables of dimensions given below each are a useful feature for ready reference by the student. In the Appendix typical foot-plate views are shown of various locomotives in service in Great Britain with the fittings numbered and key lists provided giving the function and name for each part.

Highway Engineering.—A text-book for students of Civil Engineering. By John H. Bateman, C. E., Member of American Society of Civil Engineers, Research Professor of Highway Engineering, Louisiana State University. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Limited. 1928. Price, 20*s*. net.

The author in his preface states that this book is intended primarily for use as a text-book for students of civil engineering in an undergraduate course in highway engineering, and is based on his notes which he has used for several years in the teaching of highway engineering. He has attempted to present the fundamental principles of the theory of highway engineering together with comprehensive descriptions of present practice. The treatment follows a definite plan in attempting to present the subject from the viewpoint of its principal divisions, namely, economics, financing, location, design, construction, maintenance and operation. The student should early understand that highway engineering is both a science and an art. Our present practice of highway engineering is based on the accumulated experience of many individuals and organisations; it owes much to extensive research investigations, particularly those of recent years . . . . This book, in order to fulfil its purpose as a comprehensive text, represents a compilation of data, descriptions of practice, and opinions from many sources. This bulky volume of 418 odd pages is very richly illustrated and will be found of the greatest service to students. It does great credit to both the author and the publishers for its excellent get-up. It is a really valuable work.

The Accuracy of Commercial Screw Threads.—By F. H. Rolt, M. B. E., B. Sc., A. M. I. Mech. E., and W. G. Ridge, B. Sc. Engineering Research, Special Report No. 4, Department of Scientific and Industrial Research.

The report deals primarily with an investigation (*a*) to ascertain the general views of users of bolts and nuts concerning the accuracy desirable in threaded parts and the suitability or otherwise of the existing British Engineering Standards Association tolerances, and (*b*) to correlate these opinions with actual measurements of samples collected from current stocks. A number of firms representative of various engineering industries were visited, and the general impression gained was that the present British Engineering Standards Association standard tolerances specified for screw threads were of the right order for average engineering works. It was also generally stated that the bolts obtainable commercially satisfied ordinary requirements, but there was a general demand for better accuracy in commercial nuts. These opinions are confirmed by the results of the measurements of the samples collected which showed that, whilst bolts are reasonably in agreement with the British Engineering Standards Association limits the nuts are generally too large. The investigation has confirmed the necessity for general improvement in the accuracy of commercial taps and for establishing satisfactory systems for gauging screw threads. The report also deals with a number of subsidiary investigations concerning the accuracy of screw threads. The report is furnished with 13 illustrations, and it may be obtained from the Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S. W. 1, or from H. M. Stationery Office, Adastral House, Kingsway, London, W. C. 2. Price, 1*s*. 3*d*. net.

Foreign Notes.

Another Housing and Town Planning Tour.—The Garden Cities and Town Planning Association, satisfied with the results of previous educational tours, organised and carried out for the benefit of members and their friends, have arranged a spring tour, which starts on 20th April and closes on 26th April. The North-East of England has, on this occasion, been chosen, and the cities to be visited are Scarborough, Hull and Doncaster. The tour has been planned specially to meet the needs of members of Local Authorities, architects, and social workers concerned in housing and town planning reform.

Big Searchlights.—The well-known lighting organisation, the London Electric Firm, of South Croydon, Surrey, have just secured an order for some searchlights of extraordinary size, namely, about 7 feet diameter, these being larger than anything that has hitherto been constructed in this country, and amongst the largest ever made in any other country. They will have a range of many miles. In addition, the firm are engaged on Naval and other searchlights (including high intensity) for various Governments; besides the new super Suez type, life-saving, fire-brigade, cinema studio and pilot house and commercial types down to 6 inches diameter.

Water Power in the United States.—The developed water power in the United States on 1st January 1928 was 12,296,000 h.-p., showing an increase of 575,000 h.-p. during 1927. The total amount of potential water power available during 90 per cent. of the time was 38,110,000 h.-p., and that available during 50 per cent. of the time was 59,166,000 h.-p. Estimates based on studies of the capacity of water wheels installed at fully developed water-power sites indicate that about 15 per cent. of the potential water power of the United States is developed at the present time. If it were feasible to develop all the water-power resources of the country, the total capacity of water wheels installed at all water-power plants would amount to about 85,000,000 h.-p.

Improvement Works at Ancona.—The Italian Government has authorised the expenditure of 7,000,000 lire—approximately £76,000—on general improvement works at Ancona. The harbour, although considered one of the finest on the south-west coast of the Adriatic and one of the best in all Italy, has not been brought completely up to date. It is, therefore, the desire of the Government that the work should be effected without delay, so that the port may be used to a fuller extent for the import of coal, timber, metals, jute, etc., and be able to handle more expeditiously the exports consisting mainly of asphalt and calcium carbide. The railway connection between Bologna and Brindisi, which links Ancona with Rome, *viâ* Fogligno and Orte, will also be extended and improved, electrification of part or whole of the line being suggested. The construction work will be carried out under the supervision of the Ministry of Public Works.

Water Power in Ontario.—"Engineering" understands that the Hydro-Electric Power Commission of Ontario is negotiating with the Gatineau Power Company for an additional supply of 100,000 h.-p. The contract calls for 60,000 h.-p., to be delivered in blocks of 6,000 h.-p. per annum, for a period of 10 years. It is also stipulated that an additional 40,000 h.-p. should be available if required. The power will be generated at the new plant, on the Gatineau River, at Chelsea, Quebec, a few miles north of Ottawa; it is to be delivered to the Ontario Hydro-Electric Commission, for distribution in Eastern Ontario, in the neighbourhood of Ottawa. The current will be distributed by means of 100,000-volt lines erected in duplicate. The previous contract of the Ontario Power Commission, with the Gatineau Power Company called for the delivery of a maximum of 260,000 h.-p. Transmission lines are now being erected to convey this current, at a pressure of 220,000 volts, from Paugan Falls, on the Gatineau River, to Toronto, a distance of over 200 miles.

South American Air Service.—The new postal air service between Toulouse and Buenos Aires was started in the first week of March and may be regarded, in a way, as an achievement, for it has necessitated a strenuous amount of organisation in order to get the mails over within the period fixed by the option accorded by the Brazilian and Argentine Governments to the Latécoère Company. At present it is only partially an air line. The mails are carried by aeroplane from Toulouse to Saint-Louis in Senegal and thence to the Cape Verde Islands, where they are transferred to vessels supplied temporarily by the Navy for conveyance to the island of Fernando-Noronha, at which place they are again taken over by aeroplanes for Buenos Aires. The journey occupies about seven and a-half days. It is intended eventually to replace the vessels by seaplanes, and it is probably in view of that substitution that the official inauguration of the complete air service has been postponed until September next. About that time it is expected that Germany will be beginning her service of airships, and probably of flying boats to South America, and although France has secured the credit of making the first move it is obvious that competition for the air traffic to South America in the future will be keen.

Proposed Extension of Rio Negro Irrigation Works.—A deputation of residents in the territory of the Rio Negro (Argentina) recently visited the Minister of Public Works to solicit his support on behalf of the proposal to construct a number of irrigation canals between Choele-Choele and Colonia Josefa, Chocorio and Frias *viâ* Conesa, Primera Angostura and Viedma, Boca de la Travesia *viâ* Pringles and Patagones, and in the northern zone of Negro Muerto. The Minister informed his visitors that as soon as the survey of the Colonia Frias canals was completed (which, it was anticipated, would be within the next few weeks) preparations would be for the construction of the proposed canal systems on the north and south banks of the Rio Negro, and that every effort would be made to expedite the work, more particularly as the Ministry had already received an application from the Buenos Aires Great Southern Railway for authority to construct the branch line, Darwin-Choele-Choele-Patagones. The same deputation later called upon the Chairman of the Local Board of the Great Southern Railway (Senor F. Guerrico), who expressed himself as being in accordance with the scheme, and assured his interviewers that as soon as Congress had sanctioned the construction of the branch in question the work would be started.

The Shannon Power Scheme.—A report issued by the Irish Free State Electricity Board outlines the plans for the distribution of current from the power station at Ardnacrusha, says the "Engineer." In the first place a supply will be given to Dublin, where the existing network will be used. The municipal undertaking will connect its transforming station with that which is being built by the Shannon Electricity Board, and the work of switching over to the new source of supply will present no difficulty. Cork and Limerick will be dealt with as soon as possible. In the opinion of the Board the interests of the country will best be served by the acquisition of all existing undertakings by the State, and negotiations are in progress for the taking over of the undertakings in Dundalk, Wexford and Clonmel. The Board has also mapped out an ambitious programme for the electrification of some 130 towns and villages where electricity is not at present available. Householders are to be assisted to wire their houses on the instalment system, and a national census is being taken of all the electricians and electrician's apprentices in the Free State in order that the problem of obtaining skilled labour may be solved with a minimum amount of delay. It is expected that the electrification of the Free State will be in full swing by the middle of next year, and in order to ensure success for the scheme the Board is preparing an extensive publicity campaign which will bring the benefits of electricity in the home and on the farm before the notice of the people.

Vacuum Brake Trials in Brazil.—The major portion of the Paulista Railway system is single track, and with the rapid development of the interior districts which it serves, the railway authorities have been faced with the problem of how best to increase the track capacity without resorting to doubling the line says the "Railway Gazette." To that end careful investigations have been made of the advantages offered by the use of continuous brake apparatus and central automatic couplers for freight service, which, in conjunction with enhanced locomotive power, will make higher speeds and heavier loads practicable. A complete series of trials was conducted with the rapid-acting vacuum automatic brake apparatus on freight trains of from 950 tons to 1,610 tons weight with 16 inches and 14 inches working vacuum and with varied marshalling. A maximum running speed of 37·3 m. p. h. was imposed, and the action of the brake tested for making service and emergency stops, rapid and show speed reductions, and gradient control. Two Baldwin Westinghouse electric locomotives of 1,350 h.-p. were used together, and these were fitted with the standard Westinghouse E. T. air-brake equipment. The trials were fully described in a paper read by Mr. J. Neville Gresham, before members of the Institution of Locomotive Engineers, on 1st March. They were, it is understood, carried out to the satisfaction of the railway administration, and amply demonstrated that the train under test could safely and conveniently be controlled, while there was a margin of power available for even heavier and longer trains.

Launch of the S. S. "Yarraville."—The launch took place on 13th February last of the second of two oil tank vessels which are being built to the order of the Vacuum Oil Company, Limited, by Messrs. Lithgows, of Port Glasgow, under the supervision of Messrs. Flannery, Baggallay and Johnson, Limited, of London. The vessel, which has been named "Yarraville," complies with Lloyd's highest class for the carriage of petroleum oils in bulk, and is built on the Isherwood system of framing to the following main dimensions: length 460 feet, breadth 62 feet 6 inches, and depth 36 feet 6 inches, the deadweight being 12,770 tons on a draught of 28 feet. The cargo is carried in nine main oil tanks subdivided by a continuous longitudinal oil tight bulkhead extending to the upper deck, while summer tanks are provided on each side in way of main oil tanks The pump room, which is situated between Nos. 6 and 7 main tanks and is extended to the upper deck, contains two horizontal duplex cargo oil pumps of Hayward-Tylor make, having a capacity of 500 tons per hour. Fuel oil is carried in a cross bunker and a tank at the forward end of the vessel, while the double-bottom under the engines and boilers is arranged for either feed or ballast water, a further ballast tank being provided under the forehold. The propelling machinery, which will be situated aft, consists of an inverted direct-acting triple-expansion engine, supplied by Messrs. David Rowan and Company, Limited, of Glasgow. Steam is supplied at a pressure of 220 lb. per square inch by three single-ended multitubular boilers, fitted to burn oil fuel on the Todd system, combined with Howden's forced draught.

Locomotive Testing Plants.—It is of interest, says the "Railway Gazette," to note that, when replying to the toast of "The Institution of Locomotive Engineers" at the annual dinner of that body, the Chairman and President, Mr. H. N. Gresley, took the opportunity of again referring to the all-important subject of locomotive testing plants and the desirability of establishing a modern plant in this country. Reference was also made by Sir John W. Pringle, Chief Inspecting Officer of Railways, to the same subject when proposing the toast, and as it would appear that the main or, indeed, the only obstacle in the way of laying down such a plant is that of its cost, it should be possible to make out a very strong case for a Government subsidy, or grant, in order that this very necessary project may be carried into effect with as little delay as possible. The use of a dynamometer car makes it practicable to ascertain with a high degree of accuracy what a locomotive is capable of performing in everyday or special conditions of running, but dynamometer cars also are expensive items to build and equip, and their use is, of course, attended by a not inconsiderable amount of expense. Even, however, though every railway were fortunate in owning a car of this description, this would not take the place of a national locomotive testing plant, for the reason principally that by the time the locomotive is ready for dynamometer tests, it is too late to carry out any very large and constructive alterations, and this particularly applies to the case of engines built for service in foreign lands and under conditions which can be reproduced to a large extent on a testing plant, but not when the design has been carried into effect in all its features and the engine is ready for a road test. Mr. Gresley's efforts in this direction are to be cordially welcomed and are deserving of complete success.

General Articles.

EXCAVATING THE WORK OF ANCIENT INDIAN ENGINEERS.

MODERN engineers, with their many skilful appliances, are often amazed at the wonderful work carried out by the ancient engineers and builders in India. The fact that many of their buildings have lasted over a thousand years is a strong evidence in favour of their skill. It is only within comparatively recent years that the full value of their work has been appreciated, as for generations no care or thought was given to the preservation of these structures. But, in spite of all the ravages of time, it is quite clear, from the remains that have been excavated by the workers, the buildings, usually temples or palaces, that the ancient Hindu engineers were men of considerable ability. In several parts of India extensive excavations are being carried on, and though, in some areas, there are few remains that give us anything like a complete idea of the buildings as they existed originally, say two thousand years ago, yet in others, by careful constructive work, the Archæological Department has been able to give us a most valuable help.

In no place has more important work been done than in Sanchi, where there are several fine structures now restored. The tope is situated on a hill 300 feet high, and is made of solid redstone blocks and has a height of 77 feet and a diameter of 110 feet at the base. The building forms the segment of the sphere. The four gateways which stand at the four cardinal points were made up from white stone which was probably brought from the Udaigiri Hills, about three miles away. Nine and a half feet from the base of the structure there is a rail surmounting the whole, about 11 feet high, and containing many pillars. The rail contains no sculptures, but there are many inscriptions which seem to be the records of the donors of them.

Louis Roussellet was deeply impressed by the sight of the Buddhist remains here. "How can I describe the impression," he writes in his delightful book of travels in India, "the impression produced by this stately mass, rising proudly in the midst of temples and colonnades, with its gigantic enclosure and sculptured portals? All is grand here, all mysterious; the eye recognises no outline with which it is familiar; and the minds become confused in view of these mighty memorials of times which hardly reveal themselves to us from behind their veils of legends." Coming near to the tope it is possible to examine in detail some of the carving that is to be found on the rails and pillars.

Around the tope at a height of 15 feet there is a berm or procession path, round which the monks used to walk when performing their worship. At present there is only a plain path, but it is now certain there was a wall somewhat similar to the large one already described, though containing some amount of sculpture. The whole of this colonnade has been discovered in the *débris*, and it is hoped in the near future to erect it. On the top, too, there was a railing, parts of which have also been discovered.

Roussellet says that formerly the summit, which is flat, was surmounted by a beautiful altar which was destroyed by the Englishmen who discovered the place in 1822. Among the fragments, which he then saw on the submit, were portions of two superimposed parasols, which were stone discs, 6 feet in diameter. Reference has been made to the rail which surrounds the whole structure. This is said to have been erected in the reign of Asoka. "Public subscriptions were opened in the principal cities to collect the necessary funds for the decoration of the Chaitya at Sanchi; and wealthy private individuals, municipalities and communities hastened to contribute thereto. As an acknowledgment of these gifts, and to perpetuate their remembrance the monks inscribed the names of the contributors on the stones of the colonnade itself; and it was the number of these inscriptions which enabled James Prinsep to reconstruct the ancient Pali alphabet, the tradition of which had been entirely lost."

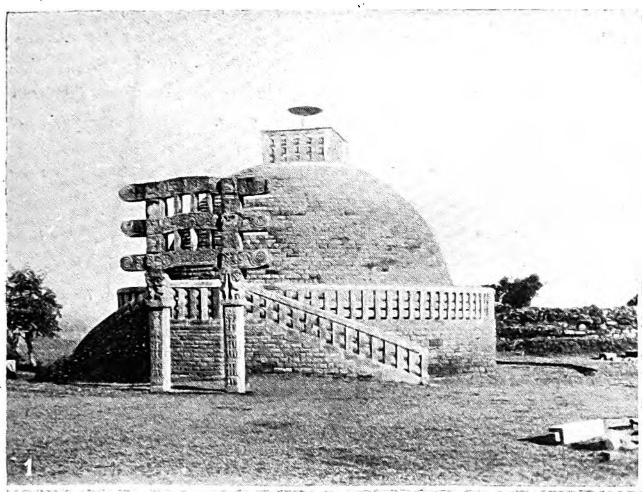
But the structures of most interest and importance are the wonderfully carved gateways which, without doubt, belong to a later period than the tope itself. At the present time the four pillars and gateways are in position, but a few years ago, the visitor would have seen only two in good condition, the others having fallen either through the carelessness of previous excavation, or the effect of time. Even engravings published within recent years, show the fallen gateways. The Emperor Napoleon the Third was very anxious to obtain one of these gateways, and solicited the Begum of Bhopal for the gift. But the Government of India would not hear of such a proposal but, as a compromise, had casts made in plaster, which were presented to him.

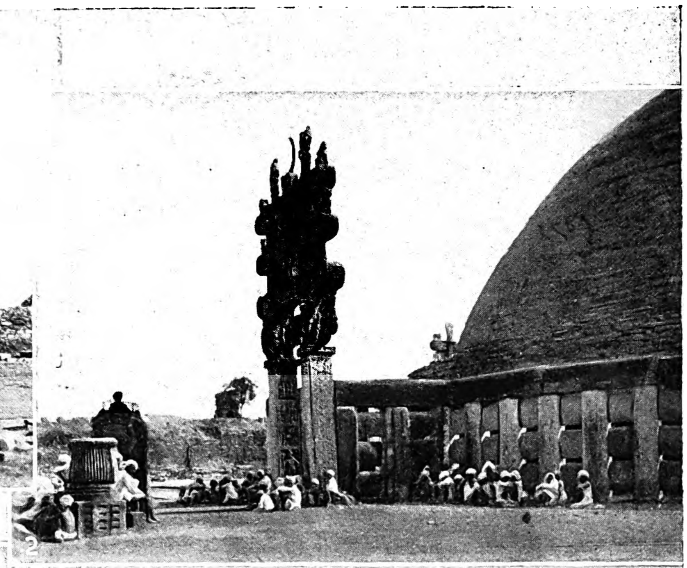
These gates are nearly 33 feet in height, and are cut in white sandstone which is an easier stone to work than the red. They are covered with bas-reliefs which illustrate the stories from the Jataka. The principal scenes in the life of Buddha, religious ceremonies, processions or royal corteges, sieges, and battles are all portrayed. There is also a series of more unpretending but doubly precious pictures which reproduced the interior of palaces, apartments with their furniture, kitchens with their accessories, and dances and gymnastic exercises.

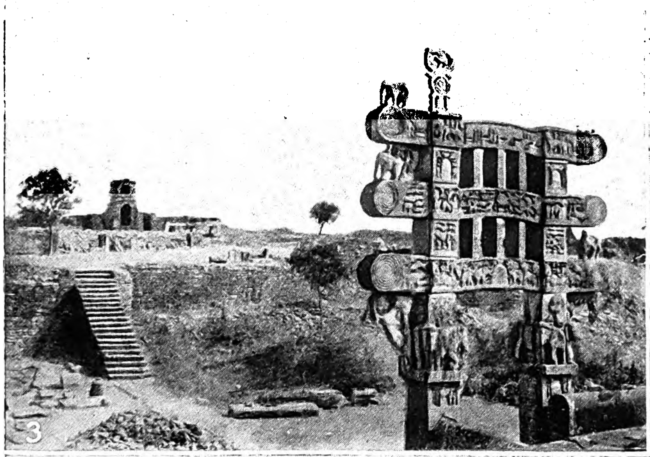
A detailed description of these would provide us with a very real conception of the life of the Indian people in those distant ages. The capitals of the pillars are composed of groups of statues highly embossed. At the northern and eastern gates they are composed of elephants in their harness, their riders floating banners; at the southern gate, recumbent lions; at the western, dwarfs standing back to back, bearing a statue of a winged lion or an elephant. The one on the north is the most perfect gate and contains carvings of great beauty and interest which can only be truly appreciated by those who are versed in the stories related of the great teacher and his followers. In the centre, on the top bar, is a broken wheel, the emblem so frequently found in Buddhist structures.

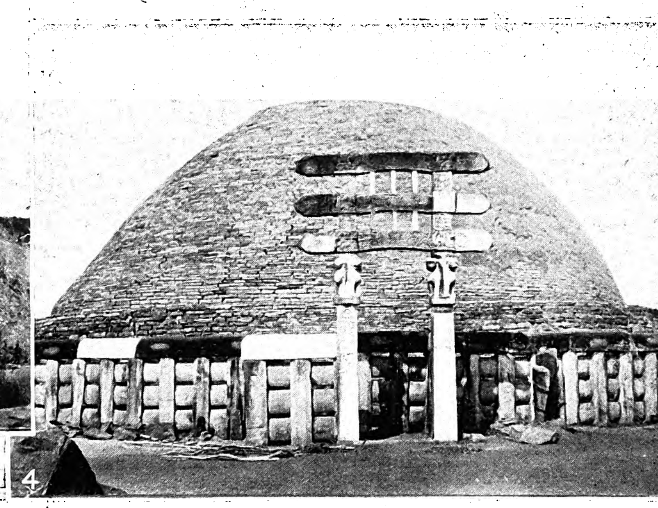
In the near vicinity of the tope there are extensive excavations being conducted under experts, and most important finds have been made. It is hoped, before long, to have a complete idea of plans of all the buildings which used to stand on this site. One of the buildings unearthed is of undoubted antiquity, and is certainly the oldest of its kind known in India. To the east there is a Gupta temple of the fourth century, and the ruins of the Chaitya Hall or Buddhist Church of great importance architecturally. Near the tope there are two large pillars which have fallen on the ground. In his account of this place Cunningham says that there "is every reason to believe these noble columns would have been standing to this day, but for the petty avarice of the neighbouring zemindars." He surmises that they pulled down these pillars in order that they might use stones for sugar mills, as they were just the size and nature for that purpose. With some of the pieces they had difficulty. When they tried to cut them across into sections of requisite size the stone split, and so they were left. These split pieces which remain are still as bright as when first made

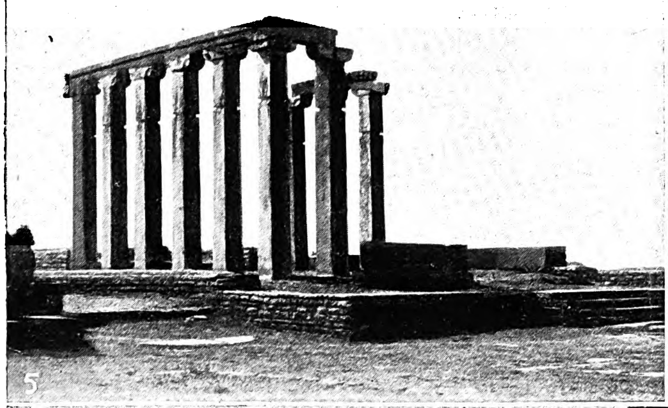
The Sanchi topes have long been known, being first discovered by General Taylor in 1818 and described by Captain Fell, 1819. For some years nothing was done to examine the buildings, but in 1868 Mr. Maddock, the Political Agent of Bhopal,

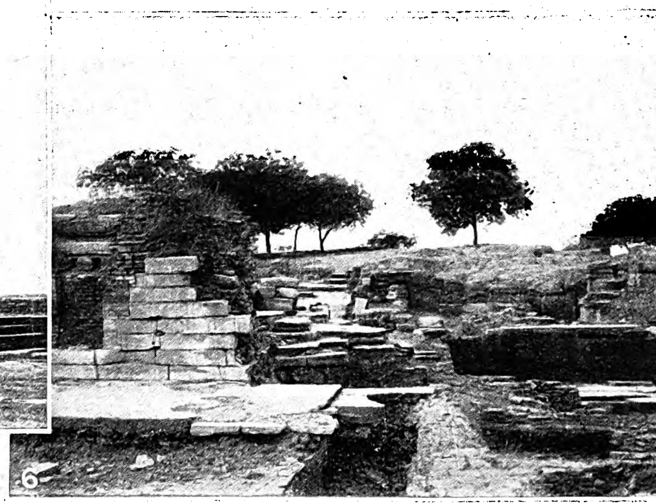


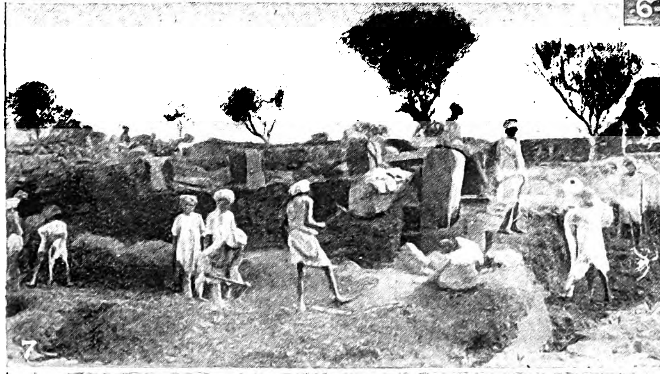


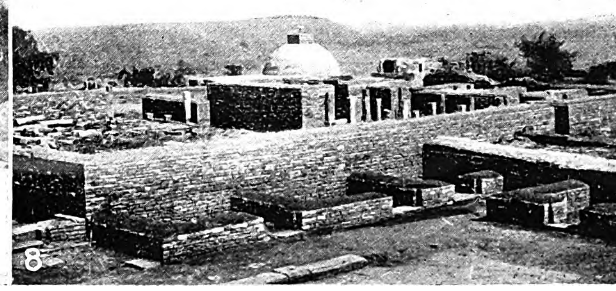












1.—The Smaller Tope Reconstruction.
2.—One of the Fine Gateways.
3.—The Upper Portion of one of the Gateways.
4.—The Main Tope.
5.—A Reconstructed Temple.
6.—Some of the Excavations.
7.—At Work on Excavations in Sanchi.
8.—General View of Restored Monastery.

EXCAVATING THE WORK OF ANCIENT INDIAN ENGINEERS.

carried out some excavations. These were, however, carried out carelessly, and resulted in damage to the structure. Till 1881 nothing more was done. Then the breach they had made was closed in and the two pillars which had fallen were erected. Fergusson gave considerable time to this place, and published his results in his great book, "Tree and Serpent Worship." There is still much to be discovered at Sanchi, but much new matter will be made public when the present Director publishes his results.

THE PYRAMID ELLIPSE.

THE following considerations reduce calculation materially and the results would not affect economy in earthwork to any extent worth remark. The reader will note, since earthen channels must alter with flow, that it is better they should change according to plan, and not fortuitously.

In factorized units; if W be the surface width of a Pyramid Section, with side-slopes 5 horizontal to 3 vertical; and x, the bed-width; and d, the depth, = 3 units; let, uniformly, the major diameter of a closely inscribed ellipse $= W - 8 = x + 4$.

The f of the ellipse therefore :—

$$= \frac{6\,(x+4)}{4\sqrt{\left\{\frac{(x+4)^2 + 36}{2}\right\}}}$$

The following table gives the values of f for the corresponding x from 5 to 50, which contain what would be about the practical limits of construction; and some others in extension.

x	f_e	x	f_e
5	1·765	30	2·089
10	1·950	35	2·097
15	2·023	40	2·102
20	2·058	45	2·106
25	2·077	50	2·108
60	2·1121	200	2·1206
70	2·1143	300	2·1209
80	2·1160	400	2·1211
90	2·1170	500	2·1212
100	2·1178	600	2·1213

Factorization as above shows clearly what has long been suspected. [In order to arrive at a more accurate understanding the reader should calculate the above f to at least eight accurate places of decimals, to obtain accurate square roots to four places (by arithmetic not logarithms) and V_0 correct to three places.]

The fact emerges that if V_0 for $x = 200$ is 3 feet per second, then (for the same d) the V_0 for $x = 600$ is about 3·00032 feet per second. This incredibly small increase in V_0 would enlarge, with the same d, the f_e from 2·1206 to 2·1213. If a flood were rising and coming down with a majestic slowness, giving ample time for the channel to widen and the current leisure to remove the eroded silt, and if the ultimate quantity of flood water sufficed, then x would steadily increase from 200 to 600. If still there was more flood-water arriving than this widened channel at the new $V_0 = 3·00032$ could convey, there *might be* an increase in d, a new V_0, and a different channel, with perhaps another x less again than 600. Factorization, in this easy and convincing manner, explains the "vagaries and mysteries" of behaviour of huge rivers like the Ganges.

Σ. Φ.

16th January 1928.

THE WORLD'S LATEST LUXURY SHIP.

THE electrical plant and apparatus with which the M.V. "Bermuda" is equipped is one of the most comprehensive in any ship afloat. The vessel has been planned throughout so as to afford passengers, on the one hand, the most luxurious conditions of travel, and on the other, the highest degree of safety attainable. It is therefore only natural that wide use has been made of the various applications of electricity in order that these objects may be achieved. Not only in point of magnitude is the electrical equipment of the vessel noteworthy, it also possesses many unique features of interest in that the design and construction of many individual items of apparatus have had to be carried out with a view to meeting special requirements, some of them of an artistic nature, others relating to the performance of special duties.

The M.V. "Bermuda" is a vessel of about 20,000 tons which will convey America's most wealthy citizens between New York and the beautiful islands of Bermuda. She was constructed by Messrs. Workman, Clark, the famous Belfast shipbuilders, to the design of Messrs. William Esplen, Son and Swainston, of London.

The whole of the electrical plant and apparatus, with very few exceptions, was manufactured and supplied by the General Electric Co., Ltd., Kingsway, London. As proof of the magnitude of the contract, it will be of interest to quote a few figures showing the quantities of the most important classes of equipment supplied. These are as follows :—

Four 300 k. w. direct current generators.
A 23-panel main switchboard, 54 feet long.
150 "Witton" motors with total capacity of 2,500 h.-p.
3,500 lighting fittings of various types.
6,800 Osram lamps.
500 "Magnet" fans for cabin and saloon ventilation.
300 "Magnet" cabin heaters.
100 telephones.
6,000 switches and control units.
10 electric lifts.
36 "Magnet" electric cleaners.

This list takes no account of apparatus for communication purposes, such as the fire alarm system, luminous and mechanical bell indicators, telephone switchboard, submarine signalling apparatus, "Gecophone" wireless broadcast and entertainment equipment, and so forth; neither does it include a figure which is perhaps the most impressive of all, namely, that no less than 140 miles of wire are necessary for the distribution of power to the various points at which it is required. These wires and cables were manufactured throughout at the Pirelli General Cable Works, one of the associated factories of the G. E. C.

The various ways in which electricity is used for communication aud signalling purposes on the vessel are full of interest. For communication between passengers and stewards a luminous indicator system is utilised. Calls from a passenger are shown visually on an alleyway indicator which is fitted with small lamps placed behind a lettered or numbered screen. This lamp indicates to a steward or stewardess passing along the main corridor that a call has been given from one of a group of cabins, and also which individual cabin has called. All corridor indicators on each deck are connected to a master indicator situated in the deck pantry. This indicator has one lamp corresponding with each alleyway indicator. A still further master indicator is placed in the bureau, having one lamp to correspond with each deck pantry, and a similar master indicator is placed in the second steward's office.

One great advantage of the system is that though the bell is intermittent and only rings when the push is operated, the light remains illuminated the whole

time until the call is cancelled by the steward or stewardess or by the passenger at the push itself, by the simple expedient of turning a ring provided for the purpose. Thus every call must receive attention with the minimum of delay.

A large number of ship type telephones are employed in various parts of the boat. They are controlled by a 70-line deck pattern central lamp signalling telephone switchboard. Apart from its function for communication purposes this switchboard is fitted with connections so that it can be connected to shore exchanges when the ship is in port, rendering it possible to speak from any of the telephone instruments connected to the switchboard to any subscriber on shore, whether the shore exchange be central battery, magneto ringing or automatic. In addition to the central battery telephone installation just described, there are a large number of intercommunication telephones which greatly assist in the smooth running of the ship, and in catering for the convenience of passengers.

It is naturally of the utmost importance that in case of fire means of communication should be as perfect as is humanly possible. The system which the G. E. C. has supplied provides a most prompt and reliable means for ensuring that immediate communication which is so essential. A number of glass fronted locking pushes are disposed in convenient positions in the ship.

A luminous indicator, situated on the bridge so as to be under the observation of the officer on watch, is used in conjunction with the pushes to show the origin of the alarm. An alarm bell controlled by a continuous action relay is placed adjacent to the indicator to draw attention to the call. Incorporated in each of the pushes mentioned above is a socket for a telephone jack, while for each push a telephone jack socket is incorporated in the luminous indicator. Two telephone hand combinations are suspended in the luminous indicator. Also adjacent to the luminous indicator is a switch controlling the alarm bells placed in the crew's quarters.

When an alarm is given by breaking a glass at the call point and depressing the push button, the corresponding lamp in the luminous indicator is lighted, and the bell at the indicator is rung. The officer of the watch, on observing this, will first of all despatch a man with a portable telephone to the call point in question, where he will insert his telephone plug in the socket provided at the push, and then reset the bell by depressing the button of the continuous relay provided. The action of inserting the plug automatically restores the push and introduces the telephone in the line. The lamp at the indicator will be somewhat dimmed and on noticing this the officer may insert his own telephone in the jack socket provided and communicate with the man at the call point. If it is established that the call is a genuine one, necessitating a turn-out of the crew, the officer can immediately switch on the alarm bells for the crew.

In addition to the fire alarm indicator, there is a navigation light indicator situated on the bridge to show the officer of the watch whether the navigation lights are burning satisfactorily. In the event of a navigation light failing a corresponding lamp in the indicator goes out and the bell is rung. By this means adequate warning is given.

Another interesting piece of apparatus in the chart room bridge is the "Magnet" submarine signalling direction finder. This instrument is worked in conjunction with two microphones situated one in each bow of the ship and will pick up submarine signals transmitted by submarine bells. This device is a great aid to navigation particularly in foggy weather. An important feature of this system is that once it has been installed, owing to the simplicity of its design, it is practically impossible for it to get out of order.

The wireless broadcast and entertainment equipment of the vessel is of a very comprehensive nature. The "Gecophone" apparatus installed enables a wide range of entertainment to be provided in public rooms and state rooms as may be required, independent and local control of each point being provided. It consists of a complete Orchestrola equipment, which, in addition, to the reception of wireless programmes from broadcasting stations, relays music by the ship's orchestra, gramophone selections, dramatic performances or other suitable classes of entertainment which may be in progress aboard.

CORROSION TESTS.

According to "The Metallurgist," Supplement to "The Engineer," of January last, the importance of corrosion is fully recognised by the great majority of those concerned with metals, whether in a practical or a scientific manner. Correspondingly, great advances have been made in the development and application of means of combating corrosion, whether by the use of corrosion-resisting metals or by the application of protective coverings or coatings. All those who have to deal with such materials, whether as producers or users, are faced with the problem, not only of determining in a general way the relative merits of different anti-corrosive substances, but they have also to ascertain the relative merits of individual specimens or batches of material. It is not at all surprising, therefore, that there should be an insistent call for a satisfactory test for corrodibility. This is to be standardised for the commercial testing both of corrosion-resisting metals and of protective coatings, whether the latter be of the nature of electro-deposits or of paints or varnishes. When, however, those who know most about corrosion —who have, in fact, devoted themselves almost exclusively to the difficult investigation of this subject —are asked to suggest such a test, the reply is that, in the existing state of our knowledge of the subject, it cannot be done.

An interesting example of this attitude, and of some of the facts upon which it is based, was furnished by Dr. Bengough in an address given to the London Section of the Institute of Metals in January. He dwelt on the complexity of corrosion phenomena, and showed the great number of factors which go to determine the rate of corrosion in any given set of conditions—factors many of which are entirely external to the metal itself. While these considerations and the accurate experiments by which they were upheld, will appeal chiefly to the scientific mind, the fact, also pointed out by Dr. Bengough, that the various corrosion tests hitherto suggested and tried all give results which are not only widely variable in themselves, but frequently show no consistent relation with the behaviour of the tested materials in service, must appeal also to the practical man. A test, to be practically useful, must be capable of giving results that can be reproduced with reasonable uniformity and these must be capable of some sort of consistent interpretation in terms of service value. Any test which fails to meet these requirements is likely to be misleading rather than useful. In these circumstances, it is idle for the practical man—such as the electro-plater, for instance—to call insistently for a "practical" standard test, declining to await the results of researches which will, ultimately, furnish the knowledge on which rational testing of corrodibility can be based. No doubt such a test is urgently wanted, but so are many things, such as a cure for cancer, for instance, and yet we have to await the results of further research.

It was, however, pointed out in the course of the discussion on Dr. Bengough's lecture, both by Dr. Rosenhain and Dr. Vernon, that the difficulty of testing corrodibility really arises only where the finer distinctions have to be measured. To take an extreme example, the simplest kind of test would serve to distinguish unmistakably between gold and steel in their power of resisting corrosion under almost any set of conditions. Similarly, the difference between a modern rust-resisting steel of the "austenitic" type

and ordinary mild steel, would become apparent under almost any kind of corrosion test, and it is obviously not necessary to wait for scientific refinements and precision in such cases. But at the same time there is neither need nor possibility of standardisation of such crude and rough tests as are sufficient to determine these wide differences in corrodibility. The demand for standardisation is based upon a desire for greater uniformity and precision in test results, and this, it seems, is not at present possible. None the less, for certain special purposes the difficulty may perhaps be overcome if the problem is analysed a little further. The most insistent demand for a standard corrosion test comes from the electro-platers, who are naturally anxious that a good protective electro-deposit should be distinguishable, with speed and certainty, from a poor one. If this is a question of distinguishing between deposits which differ only in a slight degree from one another, the difficulties dwelt upon by Dr. Bengough are an insurmountable obstacle, but for a coarser differentiation, which may still be useful for practical purposes, possibilities suggest themselves. For instance, in many cases of electro-deposited protective coatings, the power of resisting corrosion depends mainly on the question of porosity. The testing of porosity, however, is not dependent upon the deeper knowledge of corrosion phenomena which is essential to a true corrodibility test, and methods of attacking this narrower problem in a manner at once scientifically sound and practically useful might be studied with advantage, with a view—ultimately—to standardising one of them for particular types of protective coating. This has been done to some extent in regard to galvanised steel, and, we believe, also in regard to tin-plate. Its application to nickel-plating and to chromium-plating would seem to be possible. It is not, of course, suggested that a test which merely serves to show whether a given specimen of plating is or is not free from the grosser types of porosity is in itself a satisfactory test of the corrosion resistance of such a coating, but at least its use would serve as a protection against the poorest kinds of electro-plating, and would to that extent, meet the wishes both of the user and of the more progressive electro-platers. No doubt there are other factors, such as adhesion, which affect the value of an electro-deposit, and some of these also may prove to be capable of definite testing, even if the tests are to some extent rough in their indications. While, therefore, we cannot avoid the conclusion of Dr. Bengough that, however insistent the demand, a satisfactory corrosion test is not yet possible, it seems that the testing of specific properties which affect durability and corrosion resistance, may yet be pursued with immediate advantage.

THE RESTORATION OF THE ANCIENT IRRIGATION OF BENGAL

BY SIR WILLIAM WILLCOCKS, K. C. M. G.

A lecture delivered at the British Indian Association Hall, Calcutta, on the 6th March 1928.

(Concluded from page 196.)

28. I have already spoken of the way in which Central Bengal will be reclaimed. I shall now turn to Western Bengal. In Western Bengal I propose acting on Shakespeare's advice that "there is some soul of goodness in things evil would men observingly distil it out." The Damodar banks are veritable satanic chains, but as "what cannot be eschewed must be embraced," we shall make use of them. The different canals which originally led off from the left bank of the Damodar towards the Hooghly are called rivers. They are canals. These must first be restored and have all obstructions removed and be cleared and provided with light banks made of earth taken out of the canals. Never again shall there be the watertight compartments called banks. The initial putting into working order will be the work of the State. The working of the canals and their subsequent clearances will be left to the district boards which will keep them clean as in the past with boat tolls and other pulbandi provisions. The real passion for co-operation we see everywhere to-day is an echo of the time when co-operation was the life blood of Bengal irrigation. There will be no water rates just as there are no water rates in Egypt. Proper basin and overflow irrigation are impossible with water rates. You cannot, as they tried in Orissa, go about every year in the rice fields deciding which field received only flood water, which half flood and half rain, and which received only rain water.

29. The first year, it will be enough to work from the beginning of the left embankment on the Damodar down to the last canal north of Jamalpur. The regulator on the left bank which feeds the Banka canal will be kept open in flood and fill the Banka to overflowing and let it overflow its banks under the absolute control of the district boards. Such water mingling with rain water will fertilise it, and restore the ancient overflow irrigation of Bengal. At suitable places east of Burdwan, 10 feet wide cheap Egyptian regulators, as already described, will be built by the State and connected by canals with the Banka by existing canals or along traces of them. They will cut across banks and roads and through the East Indian Railway openings. Free use should be made of large long corrugated iron pipes which need no masonry and can be expeditiously placed. I proposed such pipes everywhere in my Mesopotamian project. We shall have them made of stuff which will not rust. We want permanent works. The existing canals from the Damodar will be cleared and provided with one or more 10 feet Egyptian regulators and cut through their satanic chains. Each Egyptian regulator left open in flood will help to ease the situation lower down, and each year's experience will be a guide for the following year. We are undertaking the difficult task of repairing old mistakes. Let us undertake them in the spirit of my old chief in Egypt, Sir Colin Scott-Moncrieff, whose motto was: "de l'audace, de l'audace, toutjours de l'audace," and who told us to let him know what we were going to do and then do it; and that if things went well we should get full credit, but if difficulties occurred he would take the blame. This is the spirit which will insure success.

30. The same action will be taken on the Midnapur river and its canals, and the banks along the river will be used as on the Damodar or wiped away altogether where the district boards desire that they be removed. The opening up of the old tanks and the old methods of irrigation by co-operation are in the hands of enthusiasts and may well be left in their hands.

31. I have held for years that sound engineering, sound agriculture and sound sanitation had a common goal, and it has been a real privilege to me to have spent a week in the Dacca and Mymensingh districts with Dr. Bentley, Director of Public Health, and Mr. Finlow, Director of Agriculture. When we were not inspecting we were discussing these subjects and I spoke with assurance when I said (in paragraph 23) that "the first thing in Bengal was to give plentifully of the rich red water of the flood and let it enrich the rain water in the fields and combat malaria." Indeed Dr. Bentley has shown incontrovertibly in his book mentioned in paragrah 22 that the increase of the rich red water of the rivers in flood and the decrease of malaria are one and the same thing in Bengal, as they are in all other deltas. I should like to remark here that the history of the Tanjore and Godaveri irrigation works teaches us that the execution and first use of irrigation works brings with it a temporary increase of malaria, where leguminous fodders are not the order of the day as they are in Egypt. The same history however teaches us that the outburst is shortlived, and is followed by a very great decrease indeed in all deltas. All things work for good when we work on sound lines.

32. Central and Western Bengal have a great claim on the most liberal treatment. Here we have the single tract in the whole British Empire, which was once very prosperous and healthy and which is to-day very poor and unhealthy. To every other tract we Englishmen can point with pride and say *Si monumentum quæris, circumspice*—"If you are searching for a monument look around you." Here we cannot. Bengal has poured millions upon millions of money into the common treasury of the whole of India, and, all this while, these two sub-provinces, between which has lain the seat of Government for 150 years, have become poorer and more unhealthy. True is the Indian saying that "there is no darkness like that under the lamp."

33. I have tried to tell the history of the decline but not the fall of these two sub-provinces. To your unique system of irrigation and your wonderful power of co-operation you owed your health and wealth in the past. Your plentiful monsoon rainfall has concealed the decay of your system of irrigation, which was led into a maze in the troublous years of the break-up of the Mogul Empire and which the English traders and seamen never saw in its real working and never understood. Your irrigation canals, in their upper reaches, carried more river than rain water. These the English called navigable rivers and treated as such and spoiled. In their lower reaches, your irrigation canals carried more rain than river water and these the English have called drains, treated as drains, and spread poverty and disease, in their very efforts to do you good.

34. The permanent settlement of your land taxes, meant for the good of the peasantry, broke down your inherited power of co-operation, and the delicate machinery of your irrigation system stopped working, and poverty and malaria took its place. But, thank God, the desire to co-operate is to-day a veritable passion among you. It is overflowing your land just as your rivers in flood mingled with the rainfall will overflow it. Irrigation and co-operation will march hand in hand and lead you to victory. Keep always before you the words with which Napoleon met his first Council of State. "We have done with the romance of the Revolution, we must now commence its history. We must have eyes only for what is real and practicable." In this way, one of the world's great men ushered in a great day. Make it your way.

35. To restore to working order its system of canals which can be everywhere traced on the ground, one by one, Bengal can fairly claim that help which it has hitherto given to the rest of India. The total area to be irrigated and already levelled for this purpose in Central and Western Bengal exceeds 10,000,000 acres, of which over 6,000,000 acres are in Central Bengal and under 4,000,000 acres is in Western Bengal. It has every claim to the whole of the Jute Export duty. The export jute tax represents capital for jute is a very fatiguing crop, and the duty on it should remain in Bengal. Ten per cent. of the money would be well spent in helping local boards to put up pumps on the co-operative principle to irrigate lands devoted to leguminous fodders. Such leguminous fodder crops would refresh the soil, improve the breed of cattle and combat malaria.

36. To my countrymen I appeal in the words of our artisan poet, words which have rung in my ears every day of my stay in this country :—

And did the Countenance Divine
Shine forth upon these level plains?
And was Jerusalem builded here
On rivers in Satanic chains?

Bring me my bow of burning gold!
Bring me my arrows of desire!
Bring me my spear! O clouds unfold!
Bring me my chariot of fire!

I will not cease from mental fight,
Nor shall my sword sleep in my hand,
Till we have built Jerusalem
In this once green and healthy land.

The Gazettes.

Burma, March 28, 1928.

Buildings and Roads Branch.

Mr. F. Tait, Temporary Engineer, in charge of the Magwe Division, is appointed, as a temporary measure, to the charge of the Taungdwingyi Division, in addition to his own duties, *vice* Mr. R. S. Andrews, M. C., I. S. E., officiating Executive Engineer, proceeding on leave.

Mr. H. Cooper Anderson, Temporary Engineer, is, on return from leave, posted to the charge of the Magwe Division, *vice* Mr. F. Tait, Temporary Engineer, transferred.

On relief of the charge of the Magwe Division by Mr. H. Cooper Anderson, Temporary Engineer, Mr. F. Tait, Temporary Engineer, is posted to the charge of the Taungdwingyi Division.

Mr. C. Innes, O. B. E., I. S. E., Superintending Engineer, is appointed as Deputy Chief Engineer, temporary rank, in the office of the Chief Engineer, Public Works Department, Buildings and Roads Branch, Rangoon, with effect from 1st February 1928.

Leave on average pay for four months is granted to Mr. A. Thompson, Assistant Electrical and Mechanical Engineer, with effect from 12th April 1928, or such subsequent date as he may avail himself of it.

On completion of the special duty to which he was posted, Mr. A. N. Chopra, I. S. E., Executive Engineer, is posted to the charge of the Tharrawaddy Division, *vice* Major R. C. Lord, M. C., Temporary Engineer, transferred.

On relief of the charge of the Tharrawaddy Division by Mr. A. N. Chopra, I. S. E., Executive Engineer, Major R. C. Lord, M. C., Temporary Engineer, is posted to the charge of the Delta Division, *vice* Mr. H. Marsland, I. S. E., Executive Engineer, transferred.

On relief of the charge of the Delta Division by Major R. C. Lord, M. C., Temporary Engineer, Mr. H. Marsland, I. S. E., Executive Engineer, is transferred from the Irrawaddy Circle to the Mandalay Circle and is posted to the charge of the Meiktila Division, *vice* Mr. J. N. List, M. C., I. S. E., Executive Engineer, transferred.

On relief of the charge of the Meiktila Division by Mr. H. Marsland, I. S. E., Executive Engineer, Mr. J. N. List, M. C., I. S. E., Executive Engineer, is transferred from the Mandalay Circle and is appointed to officiate as Superintending Engineer, Pegu Circle, *vice* Mr. A. R. B. Armstrong, I. S. E., officiating Superintending Engineer, transferred.

On relief of the charge of the Pegu Circle by Mr. J. N. List, M. C., I. S. E., Executive Engineer, Mr. A. R. B. Armstrong, I. S. E., officiating Superintending Engineer, is transferred to the charge of the Mandalay Circle of Superintendence, *vice* Mr. C. E. Scovell, I. S. E., Superintending Engineer, proceeding on leave.

Pending the arrival of Major R. C. Lord, M. C., Temporary Engineer, Mr. R. C. Bonnaud, I. S. E., Executive Engineer, Rangoon Division, is, as a temporary measure, appointed to the charge of the Delta Division, in addition to his own duties, *vice* Mr. H. Marsland, I. S. E., Executive Engineer, transferred.

Bihar and Orissa, April 4, 1928.

Public Works Department.

Babu Jadab Chandra Talapatra, District Engineer, Angul, is transferred to the Cuttack Division and is appointed to officiate as Executive Engineer of that Division.

Babu Bhuban Mohan Ghosh, Overseer and Subdivisional Officer, Phulbani Subdivision, is temporarily appointed to hold charge of the current duties of the District Engineer, Angul in addition to his own duties, with effect from the date of relief of Babu Jadab Chandra Talapatra.

Punjab, April 6, 1928.

Buildings and Roads Branch.

The leave on average pay for one month and 7 days granted to Mr. G. E. J. Haegert, Assistant Secretary to Government, Punjab, Public Works Department, Buildings and Roads Branch, with effect from 24th February 1928, is further extended by one month and 12 days on average pay, making leave for two months and 19 days in all.

Mr. D. A. Howell, Executive Sanitary Engineer, II. Sanitary Provincial Division, Lahore, took over charge of Multan Sanitary Provincial Division in addition to his own duties on 6th March 1922, from Mr. G. T. Pound, Executive Engineer, transferred.

On the transfer from the Multan Sanitary Provincial Division, which he left on 6th March 1928, Mr. G. T. Pound, Executive Engineer, joined the Rawalpindi Provincial Division on 8th March 1928, and took over charge of the Division on the 12th idem from Mr. E. S. Heard, Executive Engineer, proceeded on leave, preparatory to retirement.

Lala Mool Raj, Puri, who has been appointed a Temporary Assistant Engineer, joined the Rural Sanitary Division No. II on 16th March 1928, and took over charge of the Rohtak Drainage Subdivision on 19th March 1928, from Lala Sri Ram, Puri, Temporary Assistant Engineer, who was relieved of his additional charge.

Irrigation Branch.

Sardar Bahadur Bawa Sheo Singh, Bedi, Assistant Engineer, on return from leave joined the Dallas Division of the 3rd Bahawalpur Circle, Sutlej Valley Project, on 20th February 1928, and took over charge of that Division on the 29th idem.

Notice.

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INDIAN ENGINEERING.

SATURDAY, APRIL 21, 1928.

CIVIL ENGINEERING.

THE way in which the terms "civil engineering" and "civil engineer" are now used is one of the freaks of terminology. In olden days an engineer was a person concerned with engines of war, whose profession lay in directing the engines and weapons of warfare and in undertaking fortifications and other works of a military character. Even then the word in its origin was strained. Some years ago, "Engineering News" gave the root of the words "engineer" and "engine" as the Sanskrit *jan*, or to be born. From this came the Latin verbs *genere* and *ingenere*, and later the French verb *s'ingénier*. These words had nothing whatever to do with engines or machines; the French word *génie* with the same derivation merely means genius; *suivre son génie* is translated "to follow the bent of one's genius," whatever the form of that genius may be. But somehow the words engine and enginer or engineer (the man whose business is engines) arose, and possibly it was because success in war was in those days the most important of all things and the man who was a genius in weapons of warfare had genius of an important kind. At any rate by the time of Shakespeare the words had a definite meaning, in "Troilus and Cressida" there is the reference to Achilles, "a rare engineer," and the better known sentence in "Hamlet"—"'tis sport to have the enginer hoist with his owne petar." So enginer or engineer came to be a man in military service, the man who carried out the works for military needs. For military purposes, there had, apart from engines and weapons, to be roads, bridges and other works, and it was a long time before civil requirements of that nature were held to be sufficiently important to justify the coining of any special appellation.

But as the world became more civilised, and engineering was required for the development of a country in times of peace, men who were in no sense military men engaged in that form of work, and because they did not know what else to call themselves they called themselves engineers, and eventually to indicate that they were civilians they called themselves civil engineers. And that came late in the day, John Smeaton of Eddystone Lighthouse fame, one of the fathers of engineering in England, who died in 1792, was the first to dub himself "civil engineer." He not only called himself a civil engineer but he gave the title some significance. He founded the "Society of Civil Engineers," and so dominant a factor was he in the movement that the Society was often called the "Smeatonian," and it had as members many famous men, Robert Milne of the Blackfriars Bridge, the great John Rennie who built three London Bridges and the Plymouth breakwater, James Watt of the steam engine, Mathew Boulton, James Priestly and others. A good start had been made, and the

Society was the forerunner of the Institution of Civil Engineers established in 1818.

The term "civil engineer" then included all civilian engineers of the profession, but it does so no longer. Engineering had always a wide range of work, but as the range became much wider with the onward march of science, specialisation came into play, and we now have civil, mechanical, mining, electrical engineers, and more intricate distinctions than that. The civil engineer is now the engineer who deals with certain classes of engineering, such as bridges, canals, docks and harbours, railways and works of that kind, and the ramifications of the profession are extending so vastly that the matter may not end there. It will not be a case of civil engineers or military engineers, but engineers of many different designations to describe the special work in which they are experts.

WATERLOGGING IN SHEIKHUPURA DISTRICT.

As the Sheikhupura District of the Panjab lies in that part of the province where waterlogging has assumed a serious aspect, the recent settlement report of the district by Sheikh Nur Mohammad, M. A., P. C. S., was bound to be concerned, among other things, with this particular evil of canal irrigation. The Sheikhupura District as now formed is made up of portions of four different districts as they were prior to the construction of the Triple Canals. There had been previously a Sheikhupura Tahsil of the Lahore District, a tahsil lying on the other side of the Ravi River to Lahore, and although it had not originally been intended to irrigate this tahsil from the Lower Chenab Canal, irrigation from the Gugera Branch of this canal was extended to it. Later, there came the Upper Chenab Canal, one of the three great canals of the triple series, and it was found desirable for administrative purposes to constitute a new district, known as the Sheikhupura, with three tahsils, the Shahdara, Sheikhupura and Nankana Sahib. Waterlogging appeared in the area of which the new district is composed after the introduction of canal irrigation, and it is due to the excessive use of water by the cultivators and to percolation from the canals.

The settlement report says that the Deg, and the channels of the Upper Chenab Canal and of the Gugera Branch of the Lower Chenab Canal are the main physical features of the tract now re-assessed. The Deg is a natural drainage line, which used to carry a certain amount of water in the rains, not very much and always fitfully, and in a dry tract of country the water was welcomed. But now that there are canals the natural flow of water has increased, the drainage does harm rather than good, and in one place, the report says, the whole countryside is one continuous sheet of water and a breeding ground for mosquitoes. There is no corresponding advantage from the water, the moisture is too great and continues too long to benefit cultivation. A consequence of canal irrigation is, as usual, a steady rise of the spring level. In the Bar, the upland, portion, the rise has generally been about two feet a year or thereabouts, and as the spring level was very low before the canals were made there are no immediate apprehensions of waterlogging, though in the vicinity of the Gugera Branch patches of salt have appeared. But in the part irrigated by the Upper Chenab Canal, and especially near the main channel, the rise in spring level has been so great as to be alarming. In the villages close to the canal banks the wells are seen to be full to the brim, the waterlogging is serious and unless stemmed it will extend to the more distant estates. In the Shahdara and Nankana Sahib Tahsils the settlement officer found 14,278 acres which had lost most of their productiveness and 11,372 acres which had to be entirely thrown up as unfit for cultivation. These figures are not so very large, but then the Upper Chenab is a comparatively new canal, and unless the Canal Department arrests the mischief, it will proceed apace. The report says that the process of damage travels by stages. Its advent is heralded by unusually successful barani crops, and that may last for a year or two. Then patches of salt begin to appear in the fields and seed does not germinate on the patches. Yields diminish and the salt patches extend over whole fields. The final stage is marked by the appearance of crystals of salt on the surface; depressions in the proximity remain permanently wet and water of a rusty colour stands in them; the spring level rises and reaches close to the surface of the land; houses in the villages begin to crumble to dust and eventually collapse; an obnoxious odour is emitted by the habitations and the drinking water becomes unpleasant.

It is not a pretty picture. It bears out what we quoted the other day from the remarks of Professor Richard Lyman at one of the International Irrigation Congresses in America. Practically everywhere, he said, more or less of the land is waterlogged and ruined by excessive irrigation. Water turned on the land leads to wealth in the present, and in course of time a good farm becomes a poor one, and the poor one in further time has to be abandoned. It is a crime againt future generations to injure land, and yet though it is known that too much water is used no one prevents the excess. But India should have nothing to learn from America, she is the greatest irrigation country in the world and the Panjab is the premier irrigation province of India. It can be nothing but a disgrace to canal officers when these evils of waterlogging occur. They do not occur all of a sudden, nor are there no warnings in the past, the evils always throw their shadows in front of them, and it is lamentable that the desire to exhibit big irrigation figures in annual reports should be allowed to cause irrigation abuses to remain unchecked until they are so pronounced that the injury has to be remedied at great expense. What is wanted is less glorification of statistics and much more care in maintaining the fertility of the soil and the health of the people.

THE LURE OF SPEED.*

THERE are few of us who are not interested in motoring in one way or another, and that being so the book with the above title by a champion racing motorist is sure to make a very wide appeal. Speed may not be regarded as everything by a good many people, but it has to be admitted that from the early days of the world it has been a lure. For many purposes of life it is an advantage to possess means of rapid progression. The horse ruled the kingdom of speed for a very long time, and even then there was the ambition that the horse should be bred to go faster. It was the same with the machine, as evidenced by the difference between a modern bicycle and the old-fashioned velocipede. Transport by canals has a good deal to recommend it, but it is slow and it is difficult to make it fast, the water is not deep enough for quicker rates of movement and the banks are not strong enough to withstand a heavy "wash." So when the steam engine led to the railway locomotive the nose of canals was put entirely out of joint. No one was satisfied with a three miles an hour rate when locomotives, dragging great loads, were travelling merrily along the railway tracks. The locomotive paved the way for the mechanically-propelled road vehicle, and motors became faster and faster. The motor-car gave the idea of the aeroplane, and the aeroplane began to accomplish wonderful records of speed. Speed, in fact, has always been a potent factor in the unceasing competition.

And speed as time went on became less and less alarming. When railways were established, there were people who claimed that sixty miles an hour were a rate that human faculties could not endure, but a mile a minute is now a commonplace. Similarly, when car designers prophesied sixty miles an hour by road, it was held impossible for a man to control and steer a vehicle at such a terrible speed. All the same it was nonsense. Major Segrave says that when the 1,000 horse-power Sunbeam car was built, it was confidently announced that 200 miles an hour would be impossible as control would be beyond the limit of human capability, and that proved to be nonsense too. Major Segrave is convinced that a machine will not be devised so fast as to be beyond the control of a human being. He believes that the reaction between eye, mind and muscle is so instantaneous that, road conditions admitting, a man could drive habitually at 200 miles per hour, as easily as he could drive 100 miles an hour, and he from his experience of motor racing speaks with some authority. But of course the successful racing driver of to-day is a more highly developed organism than his prototype of twenty years ago. The book mentions Gabriel's feat in the ill-fated Paris-Madrid race of 1903 in terms of the greatest praise. The race was stopped at Bordeaux by the French Government on account of the many fatalities. The toll of lives was so heavy that the Press referred to the race as "The Race of Death." Numerous cars competed, there was other traffic, the dense clouds of dust gave drivers nothing to guide them but the scarcely visible tops of the trees that lined the road tyres were not the tyres of to-day, there were no detachable wheels or rims, yet Gabriel averaged 65 miles per hour for 342 miles, and Major Segrave says that it was, and still is, one of the greatest feats in the whole history of automobilism. Racing is now an altogether different problem, it used to be a 90 per cent. physical strain, to-day it is 90 per cent. a nervous one. In the early days the cars were so bad and so heavy to drive that brute strength was necessary to drive them, now it is matter of lighthandedness and faculties constantly alert. Knowledge of mechanics and engineering is required successfully to coax a modern racing car through a Grand Prix, the racing car is built so near the limit that ignorance on the part of the driver as to what r. p. m. the engine is capable of standing may have disastrous results. Racing is a different thing from ordinary car-driving, but its influence on ordinary car-manufactures has been immense. For instance, a large number of 8-cylinder in line engines are now incorporated in the latest models produced by manufacturers, whose names are not associated with racing, but if it had not been for racing it would have been many years before there was the 8-cylinder touring car of the present.

On the subject of road *versus* railway competition the author says that whereas railway speeds have remained much the same in the last forty years, road speeds and road comforts have increased very considerably. For passengers, the up-to-date, six-wheeled motor coach, with its smooth, lively, silent, 6-cylinder engine, its low centre of gravity, its four-wheel brakes and its pneumatic tyres is receiving much public patronage. And as regarding goods, a manufacturing company can hardly be blamed for sending its products to consumers in fleets of motor lorries. The goods go more or less direct from door to door, they have not to be transhipped and man-handled, and the cost of operating the lorries compares very favourably with the cost of rail transport. The taxation of heavy industrial motor vehicles is out of proportion to the damage which they do to the highway, compared with the wear and tear imposed by touring cars. The operator of a fleet of lorries is accordingly in the happy position that somebody else is paying for the greater part of the upkeep of his permanent way. The railway company is differently situated, it has neither a road fund or the local rates to draw upon, and it has to pay all the outgoings upon its track. It will only be by readjustment of taxation as a more equitable basis that cargoes which now travel by road will be forced back to the rail to which they properly belong. However popular road transport may be in existing circumstances, no country equipped with an expensive railway system can afford to discard it and construct roads to take its place.

* The Lure of Speed by Major H. O. D. Segrave, with a preface by the Rt. Hon. Sir Arthur Stanley, G. B. E. Hutchinson and Co., Ltd., 34-36, Paternoster Row, London.

Road engineers will be interested to read Major Segrave's remarks on camber in road construction. When Macadam introduced his methods a hundred and twenty years ago, he employed the camber principle, and with the description of road that goes by his name he was unquestionably right. But road construction has in the last few years undergone a revolutionary change, and the camber idea persists. The author contends, and not without good reason, that camber with the best modern roads of the day is an anachronism and a nuisance. It is inimical to the stability of a car. It is unnecessary, it is dangerous, and thousands of accidents are caused by it. A thatch roof demands a good slope to run off water rapidly, the same slope is not required by galvanised iron, and it can be nearly flat. The camber of the tarred and concrete road needs to be so slight that it can hardly be perceived by the eye. An excessive camber induces drivers to cling to the crown of the road, and to go to their proper side only when compelled to do so. This causes mishaps, and from the economic point of view it is bad because the traffic burden instead of being evenly distributed over the whole fabric of the road is confined to the centre. Practically, only about half the width of the road is really effective. There are other comments on what the roads of the future should be which are not without utility. The book, as the writer of the preface says, will for long be a classic in the literature of motoring. It is full of sound reasoning based on the lessons learned during a strenuous life as a motorist and it should have a definite value to all interested in automobilism.

SUPERSTITIONS.

In an earlier day, in a world full of sorrows and tribulations it is small wonder that there should have been many superstitions and an endeavour to escape from malignant spirits and hobgoblin terrors. Moreover, there is the less wonder when it is remembered that in countries where the priesthood was dominant it was to the advantage of the priests to encourage superstitions. It gave them more power when with them lay the interpretation of dreams and omens, and when a credulous people resorted to them for counsel for the purpose of attaining vain desires or of averting ill-fortune. And if with the advance of free-thought, the outcome of more rational knowledge, superstition is gradually dying out, it still lingers. The Arabs are perhaps the most superstitious of all races, they feel that there are haunting spirits around them night and day which may deliver them into the hands of the evil one. They will not throw a stone at a venture lest it might hit a Jinn, who would proceed to possess the thrower. Jinn-possession is a common superstition. The word *Bismillah* (in the name of God) is said to be based on fear of the Jinns. It is a cry for divine protection against the unseen spirits. The good and evil omens of life are too numerous to tell. There is a dread of compliments because they are resented by the jealous gods. The Eastern woman trembles if the beauty of her child is praised, it betokens bad luck, possibly death. There are talismans of all kinds to promote good luck, and proverbs galore with their warnings against undesirable conduct. The atmosphere is full of signs and symbols of good luck or bad.

And if superstitions may appear to be more rife in the East, the West is certainly not immune from them. People do not like walking under a ladder, they dare not dine thirteen at table, and rather than a house in a street should be numbered 13, action is taken to number it 12 A. Card-players and gamblers are notoriously superstitious. In bridge, importance is attached to the winning seats or to the winning cards to bring success. If we are rational we know very well that if certain seats or certain cards have had a run of luck, there is no logical reason why that run of luck will continue. At the very next deal, the winning and the losing seats, the winning and the losing cards, have exactly the same chances. We know for certain if we think about it that the past by the law of probabilities cannot affect the future. The winning seats so-called or the winning cards may have won four times running or twenty times, but the next time fortune will lie with either seats or either cards by the inexorable law of odds, and the odds will not be affected any more than if certain seats or cards had happened to win alternately. By strict logic the mascot laid on the table to bring good luck will make no difference; it will make no difference if we turn our chair round or touch wood to save us from loss; our partner may have the reputation of being a good or a bad card-holder, it is only fanatical to believe in that. We may have our sentiments in the matter, but mathematically-speaking we know that we are wrong to pin our faith to superstitious rites and observances. We can no more ensure success by such means than, as engineers, we can ensure the stability of our structures by the sacrifice of human life as was common enough in earlier days of the world.

But the moral of it all is that sentiment is a factor that it is idle to attempt ruthlessly to put aside. Superstition is dying, but it must die automatically by the gradual influence of reason and it cannot be slain at a stroke. It is important in the battle of life that we should maintain our courage and our confidence, and if the flaunting of superstition makes us uncomfortable, let us not flaunt it. If it pains us to dine thirteen lest one of us should die within the year, let us arrange for a less painful number of diners. If the wearing of a verse of the Koran sewn in a little bag or cummin seeds in a scrap of orange rag, or whatever form of mascot we may desire will give us a sense of security, by all means let us wear it. If winning seats or winning cards enable us to play a bolder game, let us choose them when we have the right to choose. If they do no good, they do no harm, and at all costs we should try to be cheerful and optimistic, recognising that there are chinks in our armour that we have to protect, a form of protection that more robust souls do not need.

Notes and Comments.

Jorhat Provincial Railway.—This railway has been handed over to the steamer companies on the condition that the funds required for running the railway and for capital expenditure should be found by the steamer companies, and that half of any profits made should be paid to the Assam Government. The railway has been handed over on a lease for ten years.

Water Shortage at Pabna.—A waterworks scheme was framed long ago, but nothing has yet been done, consequently water scarcity is being keenly felt in the town. The Ichamaty river flowing by the town has dried up. Tank water has become unfit for human consumption. The few tube wells sunk by the Municipality are now the only source of good drinking water.

Automatic Lighting Clocks.—The Calcutta Corporation propose to purchase 100 of these for lighting the streets of Calcutta as great economy will be effected by installing them, as there will be both a saving in labour and a saving in gas through simultaneous lighting and extinguishing. These automatic street lighting clocks are wound once a fortnight and when once fixed do not need any looking after.

New Nerbudda Bridge.—It is anticipated that this bridge will be completed and through communication be restored by 1st June next. The bridge will consist of six main spans of 169 feet each, supported on steel trestles 110 feet high, with two approach spans of 40 feet each, supported on brick piers on either side. The earthwork approach banks containing 13,700,000 cubic feet of earthwork are practically completed.

Persian Railway Project.—It is stated that three German concerns have secured an option for the construction of a railway to unite the Persian Gulf with the Caspian Sea. The first stage will be the construction of 65 miles of railway, terminating at the Caspian Sea by the German combine and another 65 miles terminating at the Persian Gulf by an American company, representing a British, American and French combine. The project still requires the sanction of the Persian Government.

Tests of Wear of Tyres.—A series of tests carried out at Washington State College (U. S. A.) to determine the rate of wear of tyres over various types of road surface showed that the average tyre will go more than six times as far on concrete as on ordinary macadam. It was found that the average distances travelled before failing of one type of tyre under constant load and speed on four kinds of road were as follow:—Macadam, 5,900 miles; good gravel, 6,200 miles; bitulithic, 26,700 miles; concrete, 40,500 miles.

E. I. Railway Development Scheme.—The programme drawn up is on an extensive scale and for the next five years, and involves an expenditure of over rupees five crores. It includes seventeen more lines with an aggregate mileage of over 1,442. Provision has been made for the opening of new lines of an aggregate length of some 400 miles during the current year. The Capital programme for the coming year provides for a total expenditure of Rs. 504 lakhs, new construction Rs. 204 lakhs, and open line works and rolling stock Rs. 300 lakhs.

Chandernagore Electric Supply.—The scheme of supplying this town with electricity from the power house of the Gourepore Jute Mill has made good progress. Overhead cables have already been laid over the Jubilee Bridge, which spans the river between Garifa and Hooghly and the current for Hooghly-Chinsura is supplied by the Gourepore Mill by means of these cables. The Hooghly-Chinsura Municipality have granted permission to the Electric Company undertaking the work for laying cables within the Hooghly-Chinsura Municipal area.

B. B. and C. I. Railway.—On the 15th instant this railway made another step forward by introducing further improvements in their suburban electric train service. There are now twice as many, namely 67, more electric trains running as when the new service was opened. The following are some of the facilities offered to the travelling public in consequence:—For stations between Bandra and Colaba (1) 84 trains will run daily against the previous number of 58. (2) The daily seating capacity is increased by 500 first, 5,600 second and 10,000 third class seats. (3) The running time between Bandra and Colaba is reduced by ten minutes on trains that stop at all stations. Although a number of steam trains continue to run on other sections these will gradually be replaced by electric trains.

Non-Stop Railway Run.—All railway records for non-stop runs will be eclipsed on 1st May, on which date the London and North Eastern Railway will inaugurate a service on which the famous "Flying Scotsman" train will travel without stopping from London to Edinburgh. This is a distance of 392 miles and it surpasses the present non-stop record of the London, Midland and Scottish Railway's "Royal Scot" from Euston to Carlisle by nearly 100 miles. Another English non-stop run which is longer than of any other railway in the world is on the Great Western Railways—Paddington to Plymouth service—226 miles. A fleet of ten new engines will be employed on the London-Edinburgh service and this exceptionally long run is rendered possible by the employment of a specially designed locomotive tender containing a corridor to enable the driver and fireman of the engine to be changed during that journey while the train is in motion.

Indian Railways.—Sir George Rainy, Commerce Member of the Government of India, will be the Chairman of the Central Advisory Council formed for Railways. The following members from the Central Legislative Assembly will form the Council:—Mr. G. A. Natesan, Lala Ram Saran Das, Mr. W. A. Gray, Sir Arthur Froom, Major Nawab Mohammed Akbar Khan, Sir Phiroze C. Sethna, Sir Purshotamdas Thakurdas, Sir Hari Singh Gour, Mr. Muhammad Amin Khan, Nawabzada Syed Ashrafuddin Ahmed, Lieutenant-Colonel H. A. J. Gidney, and Mr. Tarit Bhushan Roy. The following members of the Standing Finance Committee for Railways are *ex-officio* members of the Council:—Mr. A. A. L. Parsons, Mr. A. H. Ghuznavi, Rao Bahadur M. C. Rajah, Mr. Jamnadas M. Mehta, Mr. E. F. Sykes, Mr. H. C. Cocke, Mr. Nirmal Chunder Chunder, Mr. W. M. P. Ghulam Kadir Khan Dakhan, Maulvi Syed Murtuza Sahib Bahadur, Haji Chaudhuri Muhammad Ismail Khan, Mr. M. R. Jayakar, and Mr. M. S. Aney.

Irrigation Schemes in Bengal.—A long list of these is given in the Government Resolution on the Irrigation revenue report for 1926-27. The most notable is that relating to the work on the "Damodar Canal Project" which has been designed to irrigate about 200,000 acres of land in the Burdwan and Hooghly districts, which was commenced during the year. The total estimated cost of the project is Rs. 78,14,981. The capital expenditure amounting to Rs. 3,63,070 was mostly incurred on a broad-gauge siding to the headworks and the collection of materials. The Eden Canal in the districts of Burdwan and Hooghly was originally constructed for sanitary purposes, but it is now used for irrigation also. The supply of water in the canal is precarious, owing to the absence of a weir in the river Damodar. This state of things will improve when the Damodar Canal, which is now under construction, is completed.

Messrs. P. Orr and Sons, Ltd.—This well-known firm of Madras have sent us a copy of the latest edition of the catalogue of scientific instruments and drawing office requisites. Needless to say it is a most comprehensive one, and one which will be found of the greatest service to engineers, surveyors and scientific workers. There is no phase in the manufacture of scientific instruments with which the firm are not conversant, and the many additions and improvements included in this issue of their catalogue are the results of 78 years' experience. The firm are in a position to execute any class of work in their workshops, which are fully equipped, to meet all demands made upon them. In addition the firm are the sole managing agents in India, Burma, Ceylon, Straits Settlements and F. M. S. for the world-famous firm of instrument makers, Messrs. Cooke, Troughton and Simms, Ltd., and Messrs. P. Orr and Sons, Ltd., can supply any of this firm's manufactures. The catalogue is one which should be filed for reference in every engineering and survey office.

Leolite Fire Brick.—Messrs. J. H. Sankey and Son, Ltd., the old-established and well-known manufacturers of fire bricks, lumps, tiles, clay and fire cements for every description of furnace and kiln work, whose head office and works are situated at Essex Wharf, Canning Town, E. 16, but who have their Export Sales Department at 7 and 8, Norfolk Street, Strand, London, W. C. 2, have sent us a folder giving details of the "Leolite" (Regd.) Refractory Brick which they are now putting on the market, and for the manufacture and sale of which they are the sole licensees. "Leolite" is a highly aluminous refractory of exceptional quality and is specially adapted for lining pulverised coal furnaces and other high-temperature installations of a similar type. The six following exceptional features are found in this one fire brick :—Refractoriness 1,800 degrees C.; low thermal conductivity; great mechanical strength, volume constancy; avoidance of spalling and slag resistance. This "Leolite" Brick is the outcome of research to produce a refractory equal to special demands which are not entirely met by otherwise highly refractory materials unfortunately possessing some characteristic which counteracts their suitability for certain purposes. In instances wherein refractories require to withstand extreme temperatures up to 1,800 degrees C. in actual contact with slag, it will be found that the longevity of "Leolite" Bricks and Blocks considerably offsets the extra initial costs. The firm will be pleased to advise enquirers on the suitability of "Leolite" to meet any specific trouble if they will submit particulars.

Road and Railway Competition.—Regarding the much debated question of the competition between roads and railways, Mr. J. L. Clewes, transport manager of Lipton, Limited, made some interesting remarks in a lecture delivered before the Institute of Transport in England. The conclusion of the war let loose for use in other ways a very large number of motor vehicles which had previously been used for war purposes, together with a large number of skilled drivers, and when in 1919 there was a railway strike road transport received an impetus. On top of that, in 1921, the railways raised their rates from 60 per cent. above pre-war charges to about 112 per cent. to meet the greatly increased cost of materials and labour, and this action gave a further fillip to road transport as the cheaper of the two alternatives. The railways may have been perfectly justified in raising their charges in the circumstances of the time, but business people can hardly be blamed if owing to the high rates they resorted to carriage by road. The railways accordingly suffered by the competition, and in 1923 the rates were reduced to 50 per cent. over pre-war figures. In that position, Mr. Clewes said that 80 miles are now the economical limit for the conveyance of goods by road, and that for longer journeys the railways have the advantage. He pointed out a fact, which he said was often overlooked, that the last mile of a motor journey costs the same as the first mile, while with railway rates the charge per mile is reduced the further the goods are carried. According to the figures he gave, at 20 miles the road is 55 per cent. cheaper than the railway, and the road advantages become less the greater the distance until at 80 miles the railway becomes the more economical. At 123 miles the rail transit is 21 per cent. cheaper than the road. If the railways obtain general road-carrying powers, Mr. Clewes thinks an almost certain result would be the elimination of full load traffic by rail up to a distance of about 40 miles, because in the short distance rates over 60 per cent. of the total charge represents terminal services, and by road the railways could only charge conveyance on actual mileage from door to door.

Canal Revenue Establishment.—The assessment of canal revenue by the Civil Department, instead of by the Canal Department as had always been the method of procedure in the Panjab, was tried as an experiment in the Western Jumna Canal Circle, and after a prolonged trial, during which it was given every chance of success, it failed and failed very badly. It was bound to fail, inasmuch as the revenue side of the administration of a great canal system is a life-long study of which only canal officers can acquire a real and intimate knowledge. The former procedure was therefore put again into force, and the authorities are to be congratulated on the decision at which they arrived. But while the canal revenue officers, the Deputy Collectors and the Zillahdars, have been restored to the Canal Department, the "amalgamated" Patwari remains in the Civil Department, and draws his pay from the Civil Department and his bonus from the Canal Department. The arrangement is a thoroughly

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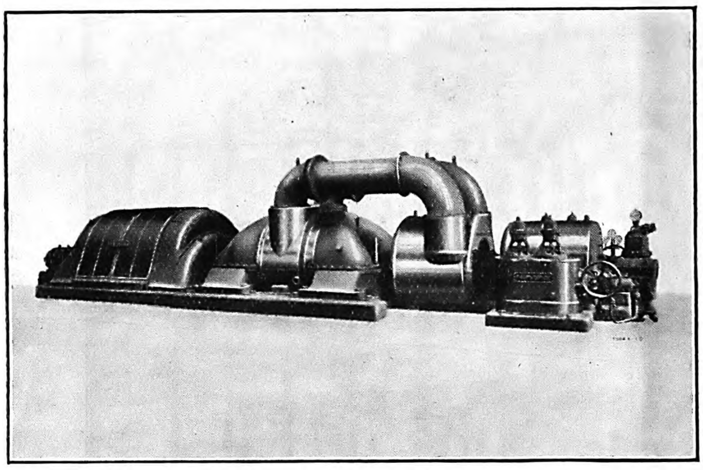

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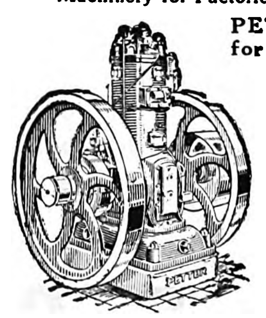

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bad one, it means that a man has to serve two masters which can never lead to satisfactory results, and it is believed that the system is proving itself to be unworkable. Presumably, this remnant of a disastrous experiment remains solely because it seemed unnecessary to have the double establishment of Patwaris, that is one set of Patwaris for the canal work and a second set for the civil duties. But although the designation, "Patwari," applied to both sets of officials, the work they are called upon to perform is distinct and there is nothing to be gained by the combination of duties. If the title is the obstacle, it should be easy to change it and to call the canal Patwari by some other name to differentiate him from the civil Patwari. The canal Patwari's duties are mainly to record in the books kept for the purpose irrigation as it occurs, and that work is very important as otherwise there might be concealment of irrigated areas, involving loss of revenue. The work, especially when the irrigators are busy, is sufficiently onerous to demand a whole-time man, and at such times it would not make for efficiency if the Patwari were to be called away by civil officers to give information on other matters. It is hoped that the present unsatisfactory arrangement on the Western Jumna Canal will soon disappear.

A Very Wonderful Engine.—When Flight-Lieutenant S. N. Webster, A. F. C., thrilled the world by winning the Schneider Trophy race at Venice at the amazing speed of over 281 m. p. h. there was much speculation as to the power developed by the Napier engine which made this wonderful achievement possible. The secret of its performance had been jealously guarded, and it was not until some three months after the race that news as to the great power that was actually developed was allowed to leak out. Certain restrictions have now been removed by the Air Ministry, and whilst it is not possible to give details as to the construction methods which have made it possible to produce such a remarkable engine, or how such a low weight to power ratio has been obtained, yet certain details as to performance may now be given. As with all the Napier Lion Series, this racing engine has 12 cylinders arranged in three blocks of four cylinders each. The bore is 5½ inches and the stroke 5⅛ inches. This latest Napier has the exceptionally high compression ratio of 10 to 1. The overall dimensions have been considerably reduced. The height is 2 feet 10½ inches, width 3 feet 2½ inches, and length 5 feet 6¼ inches. The whole frontal area of this engine, therefore, has been lessened, making it remarkably compact and easy of installation into aircraft having a small fuselage. Yet into this small area, by genius of design and skill of workmanship, is a unit developing at 3,300 r. p. m., 875 h.-p., and the engine only weighs complete 835 lb. For every horse-power actually developed 954 lb. of weight! And this Napier in the arduous Schneider Trophy race over 217 miles ran at this high power without a falter. No other engine has been produced which approaches it. The oil consumption of the engine is approximately three gallons per hour, whilst it consumes 50 gallons of fuel every hour. Another interesting item is that the winning Supermarine-Napier machine was fitted with one of these engines with an entirely new design double reduction spur gear. By the special design of gear employed the frontal area and the fine streamline shape of the aircraft were not altered, whilst the airscrew shaft instead of being above the crankshaft as in the standard Napier engine is brought coaxial with it. When a reduction gear is fitted the weight is increased to 920 lb., or 1·05 lb. per h.-p. It is one of these engines which has been installed in the racing car which Captain Malcolm Campbell has taken to America, and with which he has set up a new world speed land record of 206·9 m. p. h., travelling in one direction at over 214 m. p. h.

The Trend of Design in Marine Motors.—One of the chief features of an exhibition is its educative value in showing the direction to which engineers are devoting their knowledge and skill in the theoretical and practical problems of design. In this direction the marine motor section of the Shipping and Engineering Exhibition at Olympia last September ranks as one of the most educative shows of its kind. Everything points to a greater simplification in external appearance with cleaner lines and fewer outside fittings as exemplified in the new designs of such leading makers as Messrs. Thornycroft, Brooke and the Ailsa Craig Motor Company, Limited. In the latter company's range of engines special attention has also been paid to the production of waterproof units. Two examples of this tendency are—first the little 4-cylinder 7-12 h.-p. Ailsa Craig "Silent Seven," with its spark-plugs and ignition leads enclosed under a cover that can be instantly removed by undoing a single hand nut, and secondly their very latest model, the new 40-60 h.-p. 4-cylinder engine with a still further development not only enclosing the spark-plugs and the ignition leads, but also the flywheel, and further more effectually protecting the magneto from flying spray and heavy seas. The use of reduction gear capable of being adapted to all conditions of installation is becoming an established method of dealing with the problem of power in auxiliary yachts, heavy motor cruisers, commercial and fishing craft. It is likely that this solution of a difficult problem—first introduced by the Ailsa Craig Motor Co.—will be further extended and even more widely used than in the past, the tendency being for all new models to be designed for use either with or without reduction gear. In this connection it is interesting to note that both the new Ailsa Craig models mentioned above reflect this tendency. Another feature of the past year having a direct bearing on the future of marine motor design for small craft is the sudden rise in popularity of the small outboard-engined speed boat. Such users will inevitably demand later more permanent installations and we foresee a growing demand for the smaller inboard engines. There is already in course of development at least one interesting type of light four-stroke inboard motor to meet the requirements. As regards prices the tendency is to remain steady, heavy reductions having been made by most makers during last year. At the present levels the values offered are better than those offered by foreign makers. One thing is certain—British makers are not standing still. With compact waterproof units thought out in every detail to ensure ready accessibility, handy control and perfect reliability they stand now pre-eminent in the marine motor world and deserve the hearty backing of all devotees of water sport.

Current News.

MR. J. H. RITCHIE is appointed Secretary to the Indian Central Cotton Committee.

DR. SUHRID KUMAR ROY, Ph. D., is appointed Professor of Geology, School of Mines, Dhanbad.

IT is proposed to construct a transporter bridge across the river Yarra at Williamstown, Victoria.

A CEMENT works is to be put up at Linchow, in the Kwangsi Province of China, at a cost of about £40,000.

THE Commercial Exhibition, which was to have been held in Pekin this spring, has been postponed to the autumn.

MR. G. A. HOPKINS is appointed to officiate as Deputy Chief Engineer, Posts and Telegraphs, *vice* Mr. B. S. Singh, granted four months' leave.

MR. P. A. L. CANTIN is appointed to officiate as Chief Engineer, P. W. D., Buildings and Roads, United Provinces, *vice* Mr. Tillard, granted leave.

MR. W. B. BRANDER has been appointed to act as Chairman of the Rangoon Development Trust in the place of Mr. J. E. Houldey, proceeding on leave.

A COMPANY has been formed in Stockholm, with a capital of 24 million kroner, for the direct production of iron, steel and non-rusting iron by the Flodin electric furnace process.

THE constitution of another division has been sanctioned in the 3rd Bahawalpur Circle, Sutlej Valley Project, to be named the Nowshera Division, with headquarters at Rahim Yar Khan.

THE Ontario Hydro-electric Commission is embarking on the erection of 1,050 miles of rural transmission line. The work will cost about 2,500,000 dollars, and will serve some 6,600 consumers.

THE London Board of Trade returns for March show that imports amounted to £110,500,000, an increase of £11,600,000 over February, and exports £65,000,000, an increase of £7,700 000.

THOUGH the total value of timber products in British Columbia in 1927 was a little lower than that of 1926, exports of lumber reached a new high figure. The aggregate was 740,230,000 feet, an increase of 27,500,000 feet.

A MOTOR tug which has recently been put into service by the Cochin Harbour Board is 40 feet long by 9 feet beam, and 2 feet 10 inches draught. She is equipped with a 28-36 h.-p. six-cylinder engine by the Ailsa Craig Company, of Chiswick.

THE Government of India have taken interest in the development of civil aviation in India and have now made certain regulations which will enable civil aviation to develop more quickly. A guarantee is given of help from the Royal Air Force.

ON account of the fact that the principal thoroughfares of Pekin are to be coated with asphalt, the Metropolitan Municipal Bureau has decreed that the narrow-tyred old-style carts must have new wheels. The report does not indicate the type required.

H. E. H. THE Nizam's Government has appointed Mr. R. Blide, formerly of the Bombay Government, as economist botanist for a period of three years specially to experiment on breeding types of indigenous Goarani thus to restore Hyderabad cotton in the market.

THE new St. James Power Station at Singapore includes three main turbo-alternators of 500 kw. each, another of 2,000 kw., and a geared auxiliary set of 120 kw. Current is generated at 6,600 volts 50 cycles. The boilers are oil-fired and work at a pressure of 250 lb. per square inch.

AMONG the many methods of electrical prospecting widely used in Canada from which interesting results have been obtained is that known as the Radiore process, a high frequency method. It has been much used in the Rouyn District of Quebec for the purpose of mapping the sulphide areas on various properties.

A LAND acquisition notification appears in the "Calcutta Gazette" in connection with the construction of a line of 2 feet gauge railway from Champadanga, the terminus station of the Champadanga Branch of the Howrah-Amta Light Railway, to Tarkeswar, the terminus station of the East Indian Railway, Tarkeswar Branch.

NEGOTIATIONS have commenced in Brussels between Belgium and Portugal, as provided in the Sao Paulo de Loanda Convention, to fix the point at which the Benguella Railway of Portuguese West Africa is to join with the Bas Congo and Katanga Railway of the Belgian Congo. When effected the junction will put Portuguese West Africa in direct communication with the Union of South Africa and with Portuguese East Africa.

THE Canadian production of newsprint paper reached a total of 186,721 tons during January 1928, an increase of 25,000 tons (15½ per cent.) over the January 1927 total. The constant expansion of the Canadian newsprint industry is evidenced by the figures covering the January production in the past eight years. In January 1921 the output was 71,113 tons, in 1922, 81,072 tons, in 1923, 99,587 tons, in 1924, 110,529 tons, in 1925, 121,605 tons, in 1926, 139,688 tons, and in 1927, 161,724 tons.

Literary Notices.

Ice Cream.—A text-book for student and manufacturer. By Grover Dean Turnbow, Assistant Professor of Dairy Industry, University of California, and Lloyd Andrew Raffeto, formerly with the University of California. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Limited. 1928. Price, 20*s.* net.

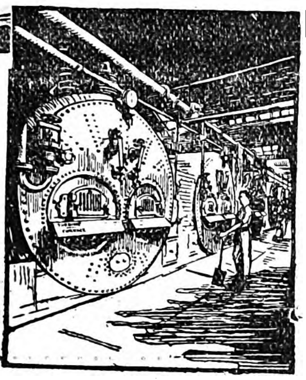
The preface states that this book was written to fill a two-fold need; namely to supply the students in the Dairy Industry with a complete and modern text-book; and to give the practical man in the commercial plant a ready reference work. While some of the subject matter may appear technical, it is difficult to cover many of the newer phases of ice cream manufacturing without dealing with the subject in this manner. No attempt is made to cover fully some of the subjects taken up in the text. For instance, a complete book might be written on the subject of bacteriology as it applies to ice cream. However, as courses dealing exclusively with these subjects are taken concurrently by the students for whom this text is designed, the subject matter here presented is intended merely to supplement these courses. The book is very fully illustrated and consists of 416 pages all told. It successfully answers the purpose for which it has been written, and will be appreciated by all for whom it is intended.

Nagpur Water Supply.—Wanna River Gravitation Project. By E. Batchelor, I. C. S. (Retired), F. G. S., Assoc. Inst. C. E. Published by "The Times" Press, Bombay, for the Municipal Committee, Nagpur. 1928. Price, Rs. 2.

The following is a brief description of the works given in this paper published as a booklet:—The works described in this paper are designed to divert for the use of Nagpur the yield of the catchments of two headwaters of the Bor River at points about two miles west of Bazargaon, and the yield of the catchments of the two branches of the Wanna River at points situated at short distances upstream of their confluence near the village of Bhuiári (Bhiári on map). The yield of the first mentioned catchments can be easily diverted into the nearer of the reservoirs of the Wanna, called in the sequel Wanna Reservoir 2. The supply will be taken from Wanna Reservoir 1 to Nagpur by a masonry aqueduct, the level of the bed of which, at mileage 4 on Highland Drive just north-west of Starky Point, will be 1,150 feet. From here the water can be taken by an inverted syphon, about 3½ miles in length, to the Service Reservoir on Seminary Hill, where the level will be about 1,146 feet. The yield of the Wanna River at a point half a mile to the north of the Nagpur-Amraoti Road can, if so desired, be diverted into the catchment area of the Ambajhari Reservoir, and onwards into the Phutala Reservoir, where the level of discharge can be about 1,050 feet, or 10 feet higher than the crest of the waste-weir of the Ambajhari Reservoir.

Experimental Researches on Reinforced Brickwork.—By A. K. Datta, B. E., C. E., A. M. I. E., Consulting Engineer, Inventor and Patentee for several systems of Reinforced Brickwork and Concrete constructions. Author of "Improved System of Reinforced Brickwork and Concrete Construction," "Improved Jack Roofing," "Investigations on Reinforced Lime Concrete," etc. Price, Rs. 10.

The present volume by this indefatigable and energetic engineer, known throughout India as one of the most experienced of experts in his special subject, will undoubtedly meet with a most cordial reception. It is a most valuable work, and will afford great assistance to all who have to do with reinforced brickwork and concrete constructions. The author conducted an extensive series of experiments on Reinforced Brickwork and its combined production with cement concrete, lime concrete and lime brickwork, first at Patna (1916-19); at the Benares Hindu University Works (1919-22) and later on (1922-24) at the Hydro-Electric Works of Sir Ganga Ram at Renala Khurd, Punjab, and last of all at Lucknow (1924-25). Most of the results of Mr. Datta's experimental researches have been contributed by him in articles which have been published in the columns of INDIAN ENGINEERING from time to time and which have been much appreciated. Mr. Datta has spent a sum of about Rs. 25,000, and a period of about ten years in making his valuable experiments. We cannot speak too highly of the merits of the present volume, and we congratulate Mr. Datta on the very successful way in which he has accomplished his task.



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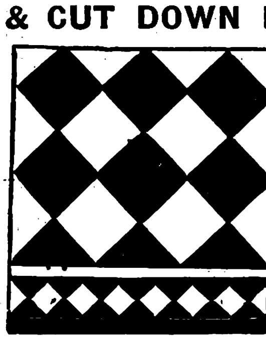

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Foreign Notes.

One-Million-Bushel Grain Elevator.—We learn that a new one-million-bushel grain elevator is to be constructed in the port of New Westminster, British Columbia, Canada. The work will be commenced immediately, and is to be completed by 1st September next. The elevator will be capable of loading ships at the rate of 25,000 bushels an hour.

18-Ton Bourdon Bell for New York.—There was recently completed at the works of Messrs. Gillett and Johnston, Croydon, the largest bell ever cast in England, weighing 18¼ tons. The bell is the fourth largest in existence and the biggest that has ever been tuned. It will constitute the Bourdon bell of the Laura A. Spelman Rockfeller Carillon, which is shortly to be installed at the Riverside Church, Riverside Drive, New York, U. S. A.

Water-Power Development in Canada.—The development of water power in Canada has, of course, had a great effect in reducing the consumption of coal. Taking into account all present conditions surrounding water-power development in Canada and comparing them with somewhat similar conditions of fuel development elsewhere, it is reasonable to assume that an annual saving of six tons of coal can be effected by each installed horse-power. This means that the total present water-power installation of 4,778,000 h.-p. will effect a saving of about 28,500,000 tons of coal per annum.

A Desert Bridge.—The construction of a macadam road in the place of the track which formerly extended from Algiers to the town of Laghouat in the oasis of that name, has provided ample facilities for transport between the north and south of the Department, but Laghouat is separated from the route by the Mzioued, which in the rainy season is often impassable. In constructing a bridge across the river difficulties were encountered, not only on account of the sandy nature of the ground but also of the heavy pressures of water during floods. The work was undertaken by the Société des Ponts et Travaux en Fer, which began the construction in March 1926, and completed it in less than two years. Foundations had to be sunk through the sand to rocks at a depth of 15·18m. There are seven spans on concrete piles. The length of the bridge, exclusive of the approaches, is 224 m., and the width is 8 m.

Construction of the Port of Antofagasta.—Although a period of twelve years was allowed, under the contract, for the construction of the Port of Antofagasta, the work, begun in the summer of 1919, has advanced so rapidly that the prospects of completion well in advance of the date are good. The work will cost, however, about £3,000,000 instead of £1,700,000, the amount of the earlier estimates. The principal construction, a breakwater 1,470 m. long, will have an arm extending to the north-east for 650 m., continued by another 820 m., long, turning in a direction due north, and affording a depth of 28 m. The port, formerly an open roadstead in the middle of Moreno Bay, will be converted into a safe harbour 36 hectares in area and ranking second in importance on the West Coast of South America. Within the protected water four ocean liners and four coasters will be able to discharge their cargoes simultaneously. The new wharves and docks, which will afford ample accommodation for the largely increased trade anticipated at the port, are practically finished.

Iraq Railways.—Before the war the only railway in Iraq was a line from Baghdad to Samarrah on the standard 4 feet 8½-inch gauge, 74 miles long, which had been built by Germany as a section of a much larger railway scheme. This section, which had been completed when the war broke out, was extended for military purposes by the British during the war from Samarrah to Sharqat, the present northern terminus. Mosul, which it is desired to reach eventually, is 70 miles distant from Sharqat, and between these two places the country is a desert. Besides the line from Baghdad to Sharqat, 186 miles of standard gauge, there is a line of 624 miles of metre-gauge between the port of Basra and Baghdad and Kirkuk. General Hammond proposes to extend the metre-gauge line from Kirkuk to Mosul as preferable to the Sharqat-Mosul route because it would pass through a cultivable area instead of a desert and would not be more than 30 miles longer. The existing line between Samarrah and Sharqat he suggests should be dismantled and the rails used for the new extension. The Baghdad-Samarrah line would be converted to metre-gauge, and the whole system would then be a metre-gauge one. General Hammond also recommends that the Tigris river at Baghdad should be bridged to supersede the present wagon ferry, which is unsatisfactory. The total cost of the scheme is estimated at Rs. 1,47,90,000 (£1,109,250).

Economical Use of Treated Sleepers.—According to the "Railway Gazette," the economies effected by the Delaware, Lackawanna and Western Railroad in renewals of sleepers have attracted attention in America, and in a paper read before the American Wood Preservers' Association, Mr. George J. Ray, the chief engineer, describes the practice of the railway. For some years past renewals have been reduced to less than 100 per mile per annum. The average number of sleepers used per mile per annum of all tracks for the 16 years 1900 to 1915 inclusive was 238, giving an average life of 11·6 years. For the 10 years 1918 to 1927 inclusive the number was 120·4, giving an average life of 23 years. For the five years 1923 to 1927 inclusive the average number was 94·5, giving an average life of 34 years. This figure, however, is exceptionally low, and it is expected that the uniform rate in future will be between 110 and 135. The chief engineer attributes these good results to the use of creosoting on an extensive scale for both construction and maintenance work, including the treatment of white oak; purchase of good uniform sleepers and use of a heavy treatment of 3½ gallons of creosote in each main-track sleeper; the use of big flat-bottom tie-plates with screw spikes, and the boring and adzing of all sleepers before treatment. By 1930 it is expected that 93 cents would be saved on every treated main-track sleeper placed in 1910. At present prices this saving would be $1·26. During the first six years more than 500,000 treated sleepers were used per annum, so that already the actual saving is very considerable.

New Rail-Joint and Frogless Turn-Out.—Two new devices are in experimental use on the Midi Railway of France, according to a recent article in the "Revue Générale des Chemins de Fer," says the "Railway Gazette." One is a rail-joint known as the "chevron" joint, with flat fishplates designed to transmit the load from a short contact surface under the railheads to two short contact surfaces on the rail flanges. The fishplates are 8¾ inches long, crowned or cambered vertically so that the top has a horizontal contact surface at the middle, only 3⅛ inches long, whereas the bottom has at each end a horizontal contact surface, 1½ inches long. There are only two bolts, which when tightly screwed up, tend to raise the rail ends slightly. Self-locking nuts are used. As the efficiency of the joints depends largely upon the tight grip of the bolts, these must be inspected frequently during the first few weeks. The other device is a continuous-rail turn-out which eliminates the ordinary frog, one effect of this construction being to reduce the wear by which the level of the point of a rail frog becomes lower than the guide rail, with consequent shock as each wheel passes. In service it has proved of special advantage for turn-outs at terminals where this track is used only for shunting movements at low speeds. Its cost is much lower than for a frog of cast manganese steel. The first trials of both devices have proved satisfactory, and more extensive trials are now being carried out.

Malleable-iron Fittings.—Records showed that iron pipes were first used for conveying coal gas about 100 years ago, and that with their use came the need for various angle and branch fittings, said Mr. H. R. Hiscott, at a recent meeting of the Institution of Heating and Ventilating Engineers. These, he continued, were made from bent tubes or from pieces of plate cut, forged to shape and welded. With the progress of casting methods it was possible to produce a much larger variety of fittings, but, owing to the lack of ductility of ordinary grey-iron castings, due to the high carbon content, research was carried out to provide a specially constituted iron for malleabilising, in which the carbon was almost wholly "combined." This research on malleable iron took a considerable amount of time, but we have to-day high-grade malleable-iron fittings which by reason of their cleanness of finish and accuracy of screwing, strength and other physical properties, are well suited to the engineer's requirements for general use and also heat and pressure. In the operation of screwing, accurate fitting demanded that all outlets should not only be screwed to perfect gauge diameter to make satisfactory joints, but connections made with them should be perfectly square and in line with the fittings. Constant testing during operation was essential to provide fittings which under tensile stress showed from 45,000 to 56,000 lb. per square inch. On the question of cost they now compared with wrought iron, gas and steam qualities.

The Measurement of Power.—In a paper read before the North-East Coast Institution of Engineers and Shipbuilders, on 9th March, Mr. J. S. Brown, M. B. E., dealt with the subject of power measurement in connection with the work of the Marine Oil-Engine Trials Committee, and described an experimental investigation into the errors met with in the use of indicators, carried out at the Royal Technical College, Glasgow. After reviewing the history of the subject of indicator errors, the author pointed out that the errors originally disclosed in the diagrams of steam engines, where the mean pressure was, perhaps, half of the pressure range, would have much more serious consequences in an oil engine with a mean pressure of only one-fifth of the maximum pressure. The various components of an indicator outfit were individually examined and tested, and the results were exhibited in the form of graphs. It was shown that the "mechanism factor" in general increased directly with the speed, the height of the diagram, and the reduction in area of the indicator piston, and could be expressed in lb./sq. in. mean pressure in terms of these quantities. The errors due to the cord and to the indicator pipe could also be ascertained in terms of mean indicator pressure by suitable formulæ, given in the paper. The author concluded that by the use of the expressions which he deduced, the more prominent errors could be evaluated, and could be used as corrections for diagrams taken in the ordinary way. Such corrections could only be approximate, but their use would rationalise the comparison of the performances of different engines. Actual examples showed that the necessary aggregate correction might amount to about 5 per cent. of the mean pressure shown by the cards, and this correction might be positive or negative, depending on the speed of the engine.

Arc Welding for Buildings.—The use of arc welding for building construction has been proved to be not only entirely safe, but also cheaper than riveting. According to Mr. G. D. Fish, consulting structural engineer of the Westinghouse Company, U. S. A., tests prove that arc-welded joints can be made stronger in every way than the members joined, and that arc-welded girders can be made to resist greater stresses than riveted girders of the same dimensions and weight. A number of arc-welded buildings have been erected, and tests made on the completed structures have shown that the strength of the joints conforms accurately to calculations. There is a reduction in the tonnage of steel required, and a saving per ton in the cost of the steel handled. Tonnage is saved by the use of lighter members and the elimination of much connecting material. For example, a five-storey arc-welded building contains 12 per cent. less steel than would a similar riveted building. In a welded railroad bridge now under construction at Chicopee Falls, Mass., the amount of steel being used is 33 per cent. less than that needed for riveted construction. Savings in the cost of handling are due to the fact that a very large proportion of the punching, fabrication, and detailing essential for riveting is not needed with arc welding. In an arc-welded building erected at Derry, Pa., 60 per cent. of the steel was not fabricated, and the cost of the structure was 12 per cent. below the cost if riveted. There is nothing dangerous about welding if proper control is exercised; the only danger is that which is inherent in any new method—the lack of experience on the part of those using it. The steps necessary to ensure control are correct engineering, the schooling of welding operators, and inspection by men trained in that work. Mr. Fish states that as design economy becomes better understood, as shop arrangement and equipment become adapted to welded fabrication, as labour becomes more efficient in handling the methods, and as high-speed automatic welding reduces welding cost, the relation of cost between welded structures and riveted ones will vary rapidly in favour of welding.

General Articles.

HYDRAULIC EQUIPMENT FOR CALCUTTA DOCKS.

A FINE EXAMPLE OF MODERN ELECTRICALLY DRIVEN TREBLE RAM PUMPS.

WE are able to reproduce herewith photographs of three out of the four sets of electrically driven, horizontal, treble ram hydraulic pumps which Messrs. Glenfield and Kennedy, Ltd., of Kilmarnock, have recently supplied to the Commissioners for the Port of Calcutta for their Jetty Pumping Station at Kidderpore Dock, in connection with which the Consulting Engineer is Mr. J. Angus, M. Inst. C. E., of London.

These pumps are a fine piece of work, with rams 6¼ inches diameter and 18-inch stroke, delivering 300 gallons of water per minute against a pressure of 750 pounds per square inch, running at a standard speed of 53 revs. per minute, corresponding to a pump horse-power of 157·5 and a ram speed of 159 feet per minute. The drive in each case is given by a self-contained 210 b. h.-p. electric motor running at 415 revs. per minute, with single reduction double helical machine cut gear, the wheel being of cast steel and the pinion of steel, forged solid with the shaft, while the width of the gearing, which is totally enclosed in a sheet steel casing, is 12 inches.

The fine and clear-cut character of the castings will be obvious from the photographs, while another feature indicated is the special system of automatic lubrication for each journal on the installation. Incidentally also these views, which are taken in the heavy erecting bay of Messrs. Glenfield and Kennedy's Works at Kilmarnock, show the ample head room available for dealing with work of the largest character, the height for example from the overhead crane rails to the floor being 40 feet.

Further in connection with dock work at Calcutta, Messrs. Glenfield and Kennedy have just received some additional important orders for the hydraulic installation at King George's Dock, which include two "Glenfield" hydraulic accumulators for a working pressure of 800 lb. per square inch, but with all water bearing parts tested to 1,600 lb., each having a ram 30 inches diameter by 16 feet stroke. These also represent the latest practice, with cylinder gland and guide brackets of cast steel, the baseplate, ram, crosshead and inlet pipe of cast iron, and the gland pipe bushed with gunmetal. Further, there is included in the contract a large quantity of cast iron hydraulic pipes and "specials," together with a delivery chest of cast steel, suitable for a working pressure of 700-900 lb. per square inch, tested to 2,500 lb. pressure. Finally, they also have to supply about 25 "Glenfield" cast iron hydraulic stop valves, each with gunmetal valve seat, nut, and gland, and solid forged bronze spindle, also balanced both ways to ensure ease of operation, and with the seat screwed in the body, suitable for ordinary severe conditions and tested to 2,500 lb. per square inch pressure.

INTERESTING EXPERIMENTS ON ECONOMICAL DEVELOPMENTS IN REINFORCED LIME CONCRETE, REINFORCED BRICKWORK AND REINFORCED CONCRETE SLABS.

A VERY interesting series of experiments on 1. Reinforced lime concrete slabs, 2 experiments (reinforcing rods embedded in ribs of cement mortar); 2. Reinforced brickwork lime brickwork slabs (alternate ribs of reinforced brickwork in cement mortar and of brick in lime), 2 experiments; 3. Reinforced concrete slabs with 1 : 5 : 10 proportion (reinforcing rods embedded in ribs of 3 : 1 cement mortar), 1 experiment was performed by Mr. A. K. Datta, Consulting Engineer, at his office site on Ganeshgunj Square, Latouche Road, Lucknow, on 10th April 1928. Many engineers attended the tests. Amongst those present were Mr. J. Robertson, Superintendent of Construction, E. I. Railway, Mr. M. C. Bijawat, Executive Engineer, Sarda Canal, Mr. Sarkar, Municipal Engineer, Mr. Bagchi, Lucknow University Engineer, Mr. B. Mukerjee, Vice-Principal, Technical School, and many others.

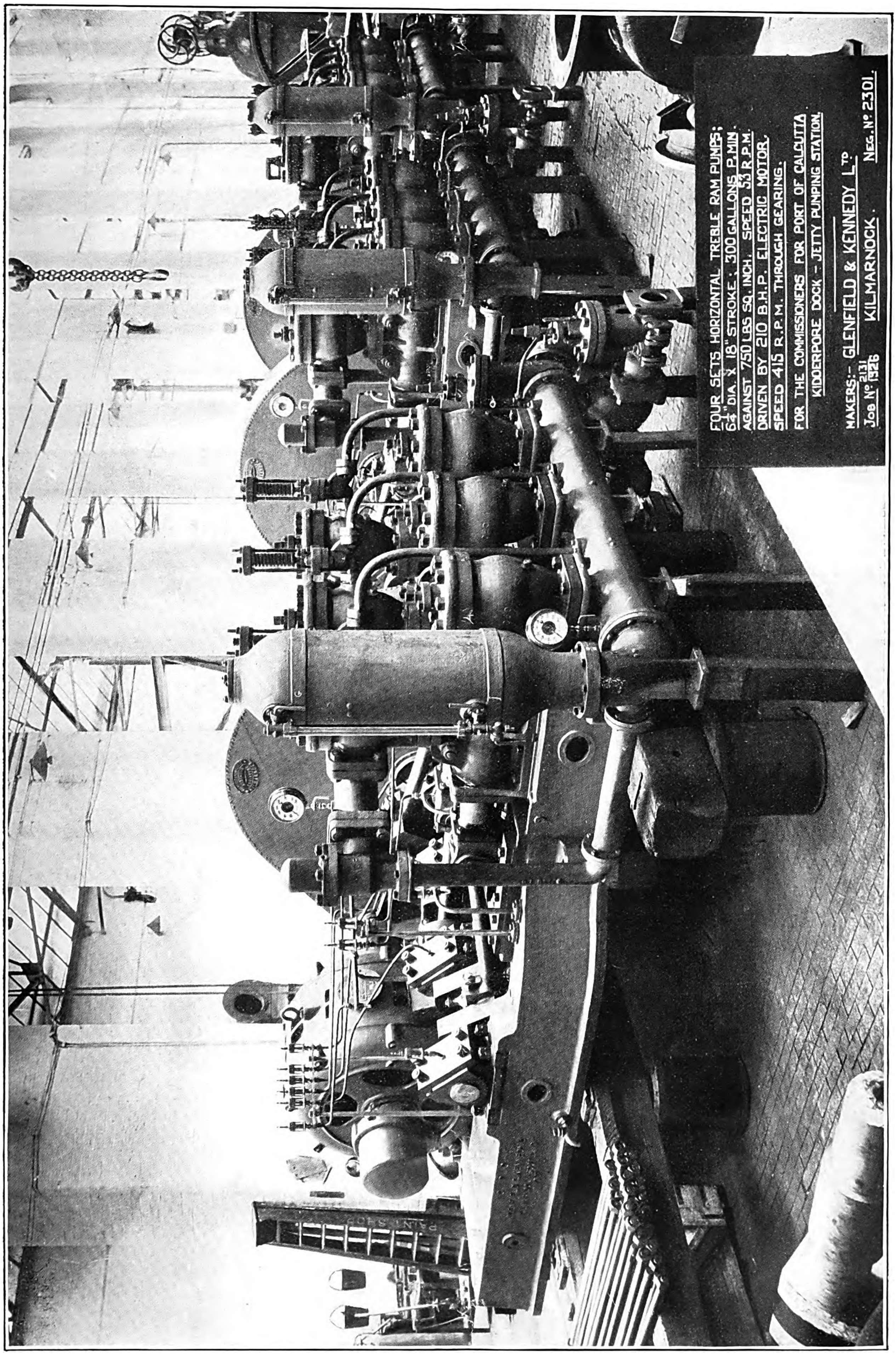
The tests were conducted by Mr. Datta and the results were found extremely interesting and satisfactory. Most of the slabs stood load of about or over 300 lbs. per square foot without showing any sign of failure. Loading weights had been left on the slabs to see to the time effect of the loading. Anybody interested can see the test slabs now with the loads on, at the experiment site.

The great development is the economy in cement and in cost in these slabs. In reinforced lime concrete slabs reinforcing steel rods were embedded in thin ribs 1¼″ × 1½″ of cement mortar (3 sand : 1 cement), contained in U-shaped tiles of burnt clay, made for the purpose and over these lime concrete was laid in, enclosing the ribs from three sides. These reinforcing ribs and the lime concrete worked as a combined reinforced lime concrete structure. On working out the cost of the slab with the current Lucknow rates it came to Rs. 21 per 100 square feet, *i. e.*, less than 4 annas per square foot. Thus the roofs and floors with these slabs will be decidedly cheaper than other kinds of flat roofs and floors now in current use. The consumption of cement in these slabs is between 1·5 to 2 cubic feet per 100 cubic feet of the work. This is probably the most economical reinforced slab invented where the reinforcing rods are embedded in cement mortar or concrete and the consumption of cement is so low.

These slabs will make excellent and economical pitching and lining for canals; they will make also excellent foundation for road work.

The other experiments are also quite interesting from the economical standpoints.

Reinforced brickwork lime brickwork slabs consisted of alternate ribs of brickwork in cement with the reinforcing rods, and ribs of brickwork in lime. The consumption of cement was very greatly reduced. The cost of these slabs came slightly above 4 annas per square foot. These slabs can be very economically used for roofs, floors of building, pitching and lining for canals, foundation for roads and for similar works.



HYDRAULIC EQUIPMENT FOR CALCUTTA DOCKS.

THE UNIVERSAL P. K. FORMULA.

I

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THE writer's present intention is to show that the equation $V_0 = C_0 \sqrt{m}$ can be applied to every case of hydraulic flow, covering all natural materials forming channels, pipes, and conduits. Refs. Nos. 1301 to 1312 from Barnes' "Hydraulic Flow Reviewed," (Darcy and Bazin, 1865, Set 2), are selected because: they refer to unalterable rectangular sections; the material, neat cement, lent itself to smooth plane surfaces and accurate shaping; and the slopes of channel bed and water surfaces were identical, removing one possible condition of inequality. The slopes were also a constant in the 12 observations. The widths of all 12 sections are assumed to be exactly as stated; 5·94 feet = zero (a finite decimal). The values assigned to m and to v are also assumed to be exact, and all finite decimals. The mean depths of all sections need recalculation to meet the above assumptions.

The i of the observations is a constant 0·0049; and agrees almost exactly with the slant length given of 1 in 204·08. The l therefore = 204·0775 +, the log of which is 2·309794, the reciprocal of the log of 0·00491, the tangent value.

TABLE A.

(log $\sqrt{l}$ = 1·154897)

Ref. No.	Observed.			Cal. d	log c (log C $\sqrt{l}$)	log C from $v = C\sqrt{m}$	Sections.	
	v	m	d				x	f
1301	3·34	·168	·18	·1781	2·065988	·911091	100·060	2·8303
1302	4·39	·251	·28	·2742	2·097525	·942628	64·989	2·7464
1303	5·04	·322	·36	·3612	2·103400	·948503	49·336	2·6747
1304	5·68	·375	·43	·4292	2·122229	·967332	41·519	2·6212
1305	6·08	·430	·50	·5028	2·122067	·967170	35·442	2·5656
1306	6·51	·474	·56	·5640	2·130589	·975692	31·596	2·5213
1307	6·83	·518	·63	·6274	2·132153	·977256	28·402	2·4768
1308	7·12	·558	·69	·6871	2·134060	·979163	25·936	2·4364
1309	7·41	·595	·76	·7441	2·137456	·982559	23·950	2·3990
1310	7·63	·632	·80	·8028	2·137063	·982166	22·196	2·3616
1311	7·86	·665	·86	·8569	2·138909	·984012	20·797	2·3283
1312	8·07	·696	·91	·9090	2·140466	·985569	19·604	2·2970

It is clear that all the sections are dissimilar, and that, with the same l, the C of the P. K. Formula theory varies from 8·1488 to 9·6732. The "constant" c varies from 116·41 to 138·19; and it is actually constant for the same value of $v_0 = 2m$ in any section, when $c = 2\sqrt{m}\ \sqrt{l_0}$.

Let us first assume one section, say No. 1305, in which the observed v = 6·080 feet per second and Barnes' calculated v = 6·079 feet, to be the standard, and from that recast all the sections into exactly similar sections, each possessing the recorded value of m (table A.)

TABLE B.

Ref. No	b^1	d^1	Cal. d	Ref. No.	b^1	d^1	Cal. d	Ref. No.	b^1	d^1	Cal. d
1301	2·321	·1964	·1781	1305	5·940	·5028	·5028	1309	8·219	·6957	·7441
1302	3·467	·2935	·2742	1306	6·547	·5543	·5640	1310	8·730	·7390	·8028
1303	4·448	·3765	·3612	1307	7·155	·6057	·6274	1311	9·185	·7776	·8569
1304	5·164	·4388	·4292	1308	7·705	·6525	·6871	1312	9·615	·8138	·9090

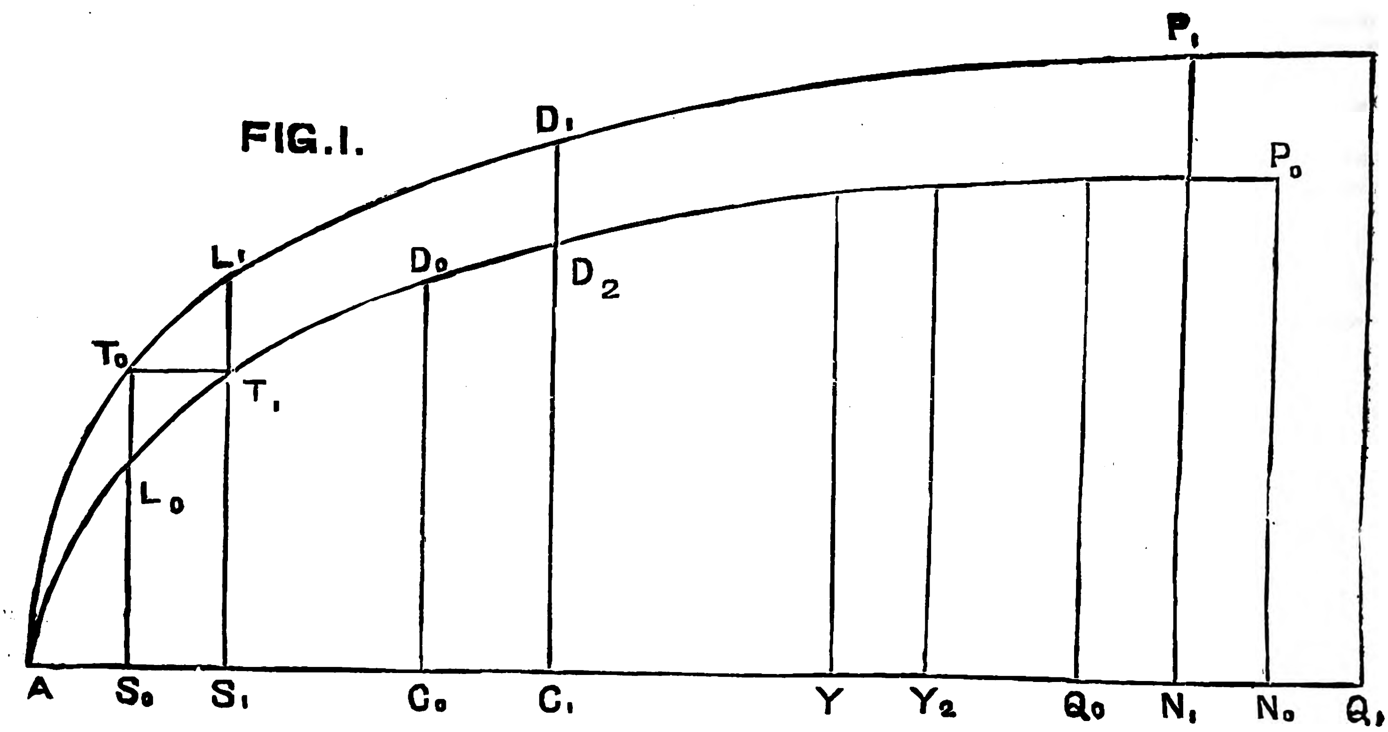
In table B, the b^1 and d^1 are worked out from the observed m; and in Ref. No. 1305 are identical with that observation, and recalculated d (see table A). By Barnes' formula, since m and l are not altered, the observed v are practically applicable. In all the sections in table B; f is a constant = 2·5656 (log. 0·409194); x = 35·442.

[The reader will note the bearing of the above on the Kennedy and derived formulæ in use to-day in all Irrigation Departments. These formulæ can only

be accurate in the working with dissimilar channels in definite series, because they all depend on *d*. Dependence on a constant *f* is quite another matter.]

The next step is to treat the parabolic theory on a different principle, to a common vertex rather than to a common focus, because in these 12 observations *l* is a constant and *m* the variable.

The result is the establishing of a LAW which connects all channels whatsoever by the P. K. Formula; which the writer set out to do.



The above figure shows two parabolas having a common vertex A and axis AQ_1, with S_0 and S_1 the two foci. The figure is to no scale and distorted.

Let $AS_0 = m_0$ and $AS_1 = m_1$; $AN_0 = l_0$ and $AN_1 = l_0^1$.

$S_0T_0 = S_1T_1 = 2\sqrt{m_0}\ \sqrt{m_1}$; $S_0L_0 = 2m_0$; and $S_1L_1 = 2m_1$.

Let $AQ_0 = l$ for $v = S_1T_1$ and let $AQ_1 = l_1$ for $v_1 = S_0T_0$.

Then $\sqrt{AN_0}\ \sqrt{AN_1} = \sqrt{AQ_0}\ \sqrt{AQ_1}$.

The pair of parabolas may be applied to any pair of the 12 references; and in the tables which follow, are applied to Refs. Nos. 1304 and 1305, and to Refs. Nos. 1309 and 1310 with peculiar and impressive force. AY throughout is the constant l; log $\sqrt{l}$ = 1·154897.

TABLE C.

Ref. No.	LOGS		C	LOGS			
	v	$\sqrt{m}$		$\sqrt{AN}$ / $\sqrt{l_0}$	$\sqrt{AC}$ (to v)	$\sqrt{AQ_0}$ (to S_1T_1)	$\sqrt{AQ_1}$ (to S_0T_0)
1301	·523746	9·612655	8·1488	2·152304	·610062	2·065122	2·183840
1302	·642465	9·699837	8·7625	2·096658	·641598		
1303	·702431	9·753928	8·8819	2·048442	·647473	1·988476	2·156624
1304	·754348	9·787016	9·2754	2·034184	·666303	2·015354	2·067272
1305	·783904	9·816734	9·2719	2·004302	·666139	2·004466	2·034020
1306	·813581	9·837889	9·4557	1·991680	·674672	1·983147	2·012835
1307	·834421	9·857165	9·4898	1·973958	·676226	1·972404	1·993234
1308	·852480	9·873317	9·5316	1·959713	·678133	1·957806	1·975865
1309	·869818	9·887259	9·6064	1·949168	·681530	1·945771	1·963110
1310	882525	9·900359	9·5977	1·935675	·681137	1·936068	1·948775
1311	·895423	9·911411	9·6386	1·926468	·682982	1·924623	1·937520
1312	·906874	9·921305	9·6732	1·918132	·684540	1·916574	1·928026

If the reader will take the trouble to work out all other data (not given to save space) the following curious equations are got by factorization. Let $\frac{v}{2m} = k$.

(i) $c = v.\cot\theta = 2\sqrt{AC}\sqrt{AY} = 2\sqrt{AS}\sqrt{AN}$
$= 2k\sqrt{m}\sqrt{l} = 2\sqrt{m}\sqrt{l_0}$.

(ii) $v = 2m\sqrt{l_0} \div \sqrt{l}$.

(iii) $\sqrt{L_0} = k.\cot\theta$.

(iv) $\sqrt{l_0} = k\sqrt{l}$.

(v) $\sqrt{AC} = k\sqrt{m}$.

The great result is; the table C appears to show that: when in any pair of parabola (FIG. 1) ST is a v common to both parabolas and $= 2\sqrt{m}\sqrt{m_1}$; C *of observations being a constant value;* then for the inner parabola and m_0, the $\sqrt{l}$ = the $\sqrt{AQ_0}$ = the $\sqrt{AN_1}$ = the $\sqrt{l_0^1}$; while for the outer parabola to m_1 the $\sqrt{l_1} = \sqrt{l_0}$. **That is: the point Q_0 coincides with N_1 and the point Q_1 coincides with N_0, with C_0 constant;** in the circumstances, a strange result.

Σ. Φ.

January to March 1928.
Re-written: 16th March 1928.

(To be continued.)

EGYPT.

THE Chamberlain-Sarwat draft treaty having been refused by Egypt, the *status quo ante*, demanded by the Declaration of February 1922, as modified by the November 1924 Notes, will, if possible, be adhered to.

Let us see what is indicated by the announcement. When the scheme for irrigating the Gezira with Blue Nile supplies of rich silt-bearing water was formulated in 1920, a great outcry arose throughout Egypt, where it was fully understood that the construction of diversion works in the Sudan of the kind proposed would deprive Egyptian cultivators of fertilisers for their own lands, already feeling the need of more silt to counteract deterioration setting in through increase of intensive cultivation, which the rapid rise of population and development of irrigation was more and more calling for each year.

Recognising the reasonableness of this contention, but at the same time under pressure from those anxious to start operations on cotton-growing concessions in the Sudan, Lord Allenby promised Egypt that the storage of the dam *would at no time be allowed to exceed the quantity required for irrigating 300,000 acres cotton in the Gezira.* This was an act of self-denial, when control of the Blue Nile afforded opportunities and power to promote Lancashire cotton interests—at the cost of Egypt, it is true. Therefore forbearance was made contingent on the appointment of a Committee to consider the whole question of the possibility of diverting Blue Nile supplies to the Sudan *without injury to Egypt.* In view of the damage threatening Egypt as a consequence of any lack of restraint on the part of upstream cultivators, with unlimited resources and vast areas at their command, if no check were placed on operations already started at Sennar, the half loaf was acceptable.

In November 1924 political conspirators in Egypt—people quite distinct from the cultivators—brought about the murder of Sir Lee Stack, the Sudan Viceroy, and this foul deed produced a hasty retaliatory British announcement that the Allenby limitation was cancelled.

Quickly realising the injustice of inflicting permanent punishment on the old irrigators who had nothing to do with the murder, Sir Austen Chamberlain undertook to submit the question of Nile supplies to an Enquiry Committee of representatives from Egypt and the Sudan, presided over by a neutral chairman. Regarding the wording of the ultimatum to Egypt that followed the murder, he explained that *nobody but a fool* would believe that England thought of starving Egypt into submission by thirst (a cap that exactly fitted a great many). If there was any defect of expression, it was due to the fact that they had to act in a great hurry.

Replying to a note from Ziwar Pasha in January 1925, asking for reconsideration of the proposal to abstract water for irrigation in the Gezira, Lord Allenby said Great Britain was disposed to direct the Sudan Government to give effect to the previous instructions on the subject, on the understanding that an expert committee, composed of M. Cremers as chairman and Messrs. MacGregor, Abdul Hamid and Suleiman Pasha as members, met not later than the 15th February to arrange the basis on which irrigation should be carried out *with full consideration of Egypt's interests*, and that it should report by the 30th June. The investigation was immediately commenced and the application of the "water clause" of the ultimatum was suspended pending the receipt of the Committee's report. This report was *practically complete* when M. Cremers died of enteric. No copy, however, of the report appears to have been published. Being complete, why cannot it be made use of as the basis of a little further investigation by a fresh committee, appointed by mutual arrangement, under a neutral chairman again? The fresh report could be an appendix to M. Canter Cremer's report and could incorporate the results of four years' additional experience. Possibly the services of that eminent irrigation engineer, Sir William Willcocks, could be secured on such a committee.

It is risky to allow the Blue Nile water question to stand over, even if bounds to an infringement that should never have been permitted are set by strict adherence being enforced to the 300,000 acres limitation in the Sudan. It is difficult to undo mischief that results from annexation of river supplies, never superabundant in recent years, for irrigation purposes, because of many changes and influences being brought into play by the transfer of water from established to new areas.

If Egypt is not satisfied with recommendations of the proposed committee, the question could be taken up by the League of Nations. Nobody can be prepared to imagine that Great Britain would deliberately stand in the way if Egypt appealed or that she would oppose if Egypt applied for membership of the League apart from acceptance or rejection of the proposed treaty.

PASHA.

EXPORT SERVICE.

THE SYSTEM OF THE G. E. C.

THE prestige of British goods abroad has never been higher than it is at the present moment, a happy state of affairs due largely to the high standard of quality of British manufactures and, in a lesser degree, to the wise publicity they have been given.

Especially is this true of the electrical industry, and more particularly so in the case of The General Electric Company, Limited, a company which has specialised for some years in the export side of its business, and has brought it to a high degree of efficient service.

In other countries there is a natural desire to know what British manufacturers of electrical appliances are doing, and a still more natural desire to study the products of the G. E. C., for not only is it the largest British electrical firm, but is a firm which lives up to its boast of supplying and manufacturing "Everything Electrical."

In the development of its export trade the G. E. C. has found its Bound Catalogue to be invaluable. In all respects this catalogue is unique, for it presents a comprehensive list of standard electrical commodities and provides customers abroad with a useful book of reference. This catalogue has been issued to firms of standing dealing in electrical products, both at home and abroad, in large numbers.

As a supplement to this Bound Catalogue the G. E. C. has published a booklet entitled "Export Service" which should prove of real value to firms Overseas. While it is often possible to calculate freight, insurance and duty, etc., charges, it is seldom that the Overseas customer can accurately estimate packing and delivery F. O. B. charges, and the booklet referred to gives guidance in this matter in a very simple form.

Every article scheduled in the Bound Catalogue is covered in the booklet, and calculations are given to show F. O. B. Charges for "Standard Cases" as well as for other consignments.

The "Standard Cases" referred to constitute another development of the G. E. C. export erganisation. The quantities selected for each case have been deliberately chosen with a view to forming a normal order, while the sizes of the cases have been selected for easy handling. The cases themselves are neat and readily lend themselves for stocking purposes on the part of the consignee. A special F. O. B. rate is offered for these "Standard Cases," and as every inch of room is utilised, they obviously conduce to economy in freight charges.

A detailed description and illustration of these cases are given in the booklet.

Overseas customers will be sure to welcome this new feature in export business which the G. E. C. has introduced for their special service and convenience. Moreover, the fact that the Export Sales Organisation of the G. E. C. undertakes to give special quotations for large quantity enquiries, or to quote inclusive F. O. B. or C. I. F. prices, is another feature which will make a wide appeal.

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British exporters are often charged with lack of attention to details such as packing and C. I. F. quotations, or with failure to accommodate themselves to the needs of Overseas markets. The G. E. C. has gone a long way to disprove such charges and has given a lead which other companies would do well to follow.

The Gazettes.

Burma, March 28, 1928.

Irrigation Branch.

Mr. L. G. Nunes, I. S. E., Superintending Engineer, assumed charge of the duties of Chief Engineer, Public Works Department, Irrigation Branch, with effect from 7th March 1928.

Leave on average pay for ten months, and in continuation thereof, leave on half average pay for two months, for a total period of one year, on medical certificate is granted to Sardar Sahib Ratan Singh, Assistant Engineer, Mon Canals Division, with effect from 11th November 1927.

Leave on average pay for two months and twenty-three days is granted to Mr. R. K. Holt, M. C., Temporary Engineer, River Training Division, with effect from 23rd May 1928.

On return from leave, Mr. J. M. B. Stuart, I. S. E., Superintending Engineer, is posted to the charge of the Northern Irrigation Circle, *vice* Mr. C. C. Mackintosh, officiating Superintending Engineer, transferred.

On relief by Mr. J. M. B. Stuart, I. S. E., Superintending Engineer, Mr. C. C. Mackintosh, I. S. E., officiating Superintending Engineer, is posted to the charge of the Southern Irrigatio Circle.

Bihar and Orissa, April 11, 1928.

Public Works Department.

Babu Jagannath Prasad, Supervisor in charge of the Patna Subdivision of the Patna Division, is granted leave on full average pay for one month and a half, with effect from 16th April 1928.

Babu Radha Damodar Bakshi, Assistant Engineer, is appointed to hold charge of the current duties of the Executive Engineer, University Division, in addition to his own duties, with effect from 29th March 1928.

Punjab, April 13, 1928.

Buildings and Roads Branch.

Mr. R. Trevor Jones, M. C., Under-Secretary to Government, Punjab, Public Works Department, Buildings and Roads Branch, took over charge of the duties of Deputy Secretary to Government and Deputy Chief Engineer, Punjab, Public Works Department, Buildings and Roads Branch, in addition to his own duties, on 23rd March 1928, from Mr. W. S. Dorman.

Hydro-Electric Branch.

On transfer from the "T/S" Subdivision of the Adit Division, which he left on 17th February 1928, Mr. A. Farquharson, Tunnel Engineer, joined and took over charge of the "P/P" Subdivision of the "P" Division on 22nd February 1928, relieving P. Ram Nath, Bhardwaj, Overseer.

On transfer from the "M/P" Subdivision of "M" (Mechanical) Division, which he left on 13th December 1927, Mr. B. K. Sibou, Assistant Executive Engineer, joined the "B.L/m" Subdivision of the "B/L" (Branch Transmission Line) Division on 22nd December 1927, and took over charge of the Subdivision from Mr. K. C. Gandhi, Apprentice Engineer, on the same date.

On transfer from the "E" (Electrical Project) Division, Lahore, which he left on 1st March, Captain A. Guthrie, R. E., Assistant Executive Engineer, joined the Adit Division at Jogindar Nagar, on 5th March 1928, as an attached officer.

Irrigation Branch.

Lala Nounidh Rai, Assistant Engineer, on transfer from the Patiala Division, Sirhind Canal, which he left on 7th March 1928, joined the Bhatinda Division, Sirhind Canal, on the 14th idem.

Rai Sahib Lala Thakur Das, Executive Engineer, Public Works Department, Punjab, Irrigation Branch, is allowed leave on average pay for three months and 29 days and in continuation leave on half average pay for six days and leave on average pay for three months and thirteen days, from 18th April 1927 to 4th December 1927 inclusive.

M. Habibullah, Temporary Engineer, on transfer from the Gujrat Division, Upper Jhelum Canal, which he left on 25th February 1928, joined the Patiala Division, Sirhind Canal, on 5th March 1928.

Lala Hari Lal, Sally, Assistant Engineer, on transfer from the Lower Dipalpur Division, 1st British Circle, Sutlej Valley Project, which he left on 12th March 1928, joined the Suleimanke Division, 2nd British Circle, Sutlej Valley Project, on the 16th idem.

Rai Sahib Lala Gian Chand, officiating Executive Engineer, on transfer from the Jandiala Division, Upper Bari Doab Canal, which he left on 9th March 1928, joined the Balloki Division, Lower Bari Doab Canal, on the 19th idem, and of which he took over charge on 20th March 1928, from Mr. Nand Gopal, officiating Executive Engineer.

Mr. N. White, Chief Engineer, Public Works Department, Punjab, Irrigation Branch, is allowed leave on average pay for 4 months and 4 days and in continuation leave on half-average pay for 1 month and 26 days from 19th April 1928, or subsequent date.

Notice.

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All other communications should be addressed to the MANAGER.

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CONTENTS

INDIAN ENGINEERING.

SATURDAY, APRIL 28, 1928.

INSTITUTION OF CIVIL ENGINEERS.

THE March sessional notice of the Institution of Civil Engineers says that the proposals for the centenary celebrations of the Royal Charter are now taking definite shape, though it is too early to issue the exact programme of events. The Institution was established in 1818, but in 1918 it was felt that owing to war conditions the circumstances were not favourable for the commemoration of the centenary of the establishment of the Institution, and it was decided to make the centenary of the granting of the Royal Charter the important occasion. The latter centenary falls on the 3rd June next, and the 3rd June being a Sunday the President and Council will attend service in Westminster Abbey, where seats will be allotted for delegates and members of the Institution. The celebrations will open on the 4th June with an address by the President, followed by a formal reception of the delegates, and in the afternoon of the same day the James Forrest Lecture for 1928 will be delivered by Sir Alfred Ewing, K. C. B., M. A., LL. D., D. Sc., F. R. S., M. Inst. C. E., who will take as his subject "A Century of Inventions." On the following morning the Conference will be opened with an address by the President, and there will be meetings for the discussion of engineering subjects. The afternoon will be devoted to visits to engineering works in or near London, and the Conversazione will take place in the evening. On the next day will be whole-day visits to engineering works at a distance from London, and it is hoped that every member attending the Conference will have the opportunity of attending one of these visits. On the following morning the meetings of the Conference will be resumed, in the afternoon there will be further visits to engineering works, and in the evening there will be the Banquet to the delegates. So although the exact programme has yet to be formulated, the above information will show those in India who anticipate being in England at the time what is contemplated. And no doubt engineers in this country who are members of the Institution will endeavour to be present at celebrations of a very exceptional kind, and which they will never have a chance of attending again. They will have an opportunity of meeting the distinguished engineers of the United Kingdom and distinguished visitors from abroad, of taking part in the visits to engineering works of importance in the best of company and in the most pleasant of circumstances, and of hearing the discussions on a great variety of engineering questions of the day, in addition to enjoying all the social privileges of the occasion. It is an opportunity that should not be lost.

Regarding the Coopers Hill War Memorial Prize for 1928, the sessional notice informs competitors that they may select for their essays any subject from the list given in the pamphlet "Subjects for Papers" issued by the Institution. When the Prize, consisting of a

bronze medal, a certificate and a money reward, was first instituted, the subjects were chosen by the Council of the Institution and they always appearep to us to be very appropriate subjects. But candidates appeared to be singularly backward in taking advantage of an opportunity for distinction, and if the selected subjects did not appeal to them, they have now a wide range of choice. The papers for the coming competition must be in the hands of the Secretary of the Institution not later than the 28th February 1929; and the award is limited to Corporate Members of the Institution who are not over thirty years of age on the 1st January in the year for which the award is made. A hope may be expressed that young engineers in this country will be more eager to compete for the honour than they have been in the past. Among the selected papers which will shortly be brought forward for discussion, Indian irrigation engineers will be interested in "The Gezira Irrigation Scheme : Canalization of the Gezira" by Mr. Harmood V. C. Johnstone, O. B. E., M. Inst. C. E., and "Sluices and Machinery of the Gezira Irrigation Scheme: Blue Nile Dam and Canalization" by Mr. James R. Russell, B. Sc., A. M. Inst. C. E. There is also a paper on the "Construction of a Bridge over the Sabwet Choung on the Minbu-Kani Road, Minbu District, Burma.

THE ROADS QUESTION.

If the degree of civilization at which a country has arrived is to be gauged by the state of its roads, it has to be admitted that India has been pretty low down in the scale. Other kinds of public works may have progressed tolerably satisfactorily, but roads have languished. For railways and irrigation it came to be recognised that loan funds were essential; but loan funds for roads, it was quite an unthinkable idea. In the early days of irrigation in the Panjab, when the engineers made their budget demands for canals, it is recorded that John Lawrence was aghast at the figures. "Canal officers," he said pettishly, "seemed to think in lakhs." And what else were they to think in? They could hardly think of the cost of great irrigation systems in the same terms as John Lawrence might have thought of one of his rough and ready suits of clothes. But that seemed to be the outlook of many administrative officers in high positions. Still in course of time they became accustomed to the cost of irrigation works and of railways. They saw long lines of streams of water and of railway embankments, great bridges over rivers and canal head-works, iron and masonry structures of various kinds, and it dawned on them that all that sort of thing must mean money. Besides, railways and canals were revenue-earning works, and it was held to be justifiable to borrow money for them; but roads, they earned nothing, and their cost should not mean anything to speak of, a little demarcation on the ground, for the better roads a little metalling rammed on top, it was nothing more than that. They did not understand that the cost of a road is its initial cost *plus* the cost of upkeep, and that the cheap road, the kind of road that civil officers used to make and call a district road, was an expensive affair in the end. So it came to be that the provincial governments metalled the roads in and in the precincts of head-quarter stations and towns and some of the arterial high-ways. Even so, such roads were quite unfit for the purposes of modern traffic. Kunkur and water-bound macadam for heavy traffic were of little use; and outside the roads of that kind were the broad acres of India, where the great mass of the people lived, in villages or very small towns, and the transportation was by means of the springless vehicle, the bullock-cart. The so-called roads over which the struggling bullocks had to find a way were often depressions, and in the monsoon season and in the neighbourhood of canals and drainages they resembled water-channels more than roads. In the dry hot-weather they were dust receptacles, and had deep ruts baked by the sun into very unpleasant jolting places. Of all living creatures, the poor bullocks were in the best position to know how cruel the roads were.

In any circumstances something or other would have been evolved in time, *res nolunt diu male administrari*, and things refuse to be mismanaged for ever and ever; but then there burst upon the scene the mechanically-propelled vehicle, and roads became one of the most pressing of economical problems. The best roads called for improvement out of all recognition of anything that had existed in the past, and the worst roads, not to be called roads but merely tracks or routes, shrieked to be made into real roads. Modern transport methods demanded revolutionary action, and India for the first time became awake to the needs. It was only the other day, as it were, that the Bengal Chamber of Commerce said that there was only one good main thoroughfare, the Grand Trunk Road, and that except on this road it was difficult to go fifty miles in any direction. There was no system of main roads, no thought-out general plan, and such as the roads were, they were bad roads, mostly unmetalled, incompletely bridged, therefore inadequate for motor transport, and during the monsoon inadequate for any form of transport. When that is the position, it is obvious how radical is the measure of reform required; but when the goal is a satisfactory and comprehensive scheme for all India, not merely *intra* provinces but *inter* provinces, it can be imagined how great the difficulties are, especially as roads are a provincial subject over which the Central Government has no control. The Indian Roads and Transport Development Association has been doing good work in the desired direction, but it has a very up-hill task before it. The chief obstacle, now as always, is that of expense. The engineers are not to be blamed, given the funds they are capable of devising the necessary road systems and of constructing roads to withstand the strain of present day traffic, but roads have always been starved of funds. It is money that is wanted and it can only be obtained by loans. The loans will carry interest, and the interest charges must be met from taxation. Roads and sufficiently good roads for the traffic they have to carry are badly wanted; they are wanted as

feeders to railways and to enable producers to convey their produce to market whether railways assist in that end or not; and it is only fair that those who benefit by more roads and better roads should pay for them. As regards motor transport, the simplest method of taxation is that in terms of fuel. Great weight and speed and the attendant wear and tear all imply more fuel, and taxation of fuel is the most direct method and the most easily collected. But it would not be just to impose all the burden of the money required for road development upon the owners of motor vehicles, the better the roads the cheaper will be the cost of transport by any other way and the consequent effect on the prices of commodities. The general taxpayer, whether he uses motors or not, will therefore benefit by improved systems of roads, and has no reason to complain if he is called on to meet a reasonable share of the expense. In that aspect the Central Government, responsible for the economic welfare of the country, should give every help and encouragement to the organisation which is doing all it can to promote co-ordination in the various schemes of development in order that there may be some uniformity of policy in the measures adopted for the good of India as a whole.

THE NEW INDIA HOUSE.

THE new India House about to be constructed in London, the work of which, it is believed, has already been begun, cannot fail to be of interest in itself and still more interesting from the fact of all that it will represent. Up to the time of the passing of the Government of India Act of 1919, the home duties of the administration of India were discharged entirely by the India Office. The Act of 1919 made, however, provision for the appointment of a High Commissioner for India in the United Kingdom, and the first incumbent of the post, Sir William Meyer, who had previously been the Finance Member of the Government of India, assumed charge in 1920. The object of this separate appointment was that it should be a step in the progress of India towards responsible Government, and it separated the political and administrative functions of the Secretary of State from all agency work on behalf of the Central and Provincial Governments in India, which was placed in the hands of the High Commissioner, acting under the instructions of his own Government and with an establishment distinct from that of the India Office. The officer who now fills the post is Sir Atul Chatterjee.

The work of the High Commissioner's office is distributed between five main Departments. There is, in the first place, the Indian Trade Commissioner's Department which is concerned with the encouragement and development of the trade between India and the West. It helps in various important ways Indian manufacturers and merchants to extend their markets by means of organised trade intelligence and display of products, and it has the conduct and organisation of exhibits in exhibitions in which India participates. The India Store Department undertakes the purchase and shipment of the requirements of the Central and Provincial Governments of India which are not obtained locally. In the year ended the 31st March 1927 the value of the contracts placed by the High Commissioner was over £10 millions, the principal purchaser being the Indian State Railways. The General Department is entrusted with the recruitment of officers enlisted in England for service in India, the arrangements for officers deputed from India to Europe for courses of special study, the sale of Government publications and other miscellaneous duties. The Accounts Department pays the pensions and leave salaries of civil officers retired and on furlough, and conducts the budget and accounting work of the whole organisation, including the purchase of stores. The Education Department gives assistance to all students from India who desire help in the matter of their courses of study, and arranges for their admission to schools, universities, technical and professional institutions and manufacturing works. Through the agency of this Department, the High Commissioner protects the interests of Indians in England, and undertakes the supervision of young Indians placed by their parents or guardians under his care for educational purposes.

On the appointment of the High Commissioner, except that the India Store Department was located in Belvedere Road, Lambeth, his office was accommodated in three houses of Grosvenor Gardens, Westminster, originally built as residences, but adapted as necessary for the new uses to which they were to be put. Since then the requirements would appear to have outgrown the space afforded by these premises, and almost from the very first it was held by many people that the site was not a very satisfactory one, especially for the office of the Trade Commissioner. The general growth of business, the need of reading, writing and reception rooms, and of a modern reference library for the use of visitors and others interested in India, together with the demand for an adequate office for the Trade Commissioner in a locality readily accessible to the city of London, rendered a change desirable, and eventually a site at Aldwych, between Marconi House and Bush House, was acquired. This site has an area of about 12,400 square feet, and on it will be constructed a new building to accommodate all the Departments of the High Commissioner's office, except the India Store Department which will remain at Lambeth as at present. The design of the building is the work of Sir Herbert Baker, A. R. A., one of the two eminent architects who designed the principal buildings of New Delhi, and with him will collaborate Dr. Oscar Faber, O. B. E., as consulting engineer.

On the ground floor will be a great hall for the display of commercial exhibits, and on either side will be recesses, after the style of an Indian bazaar, for special exhibits. The great public staircase, the hall and library will express in their architecture the Indian character of the building. The walls of the hall and stairway will be of red stone, similar in appearance to Agra sand-stone, carved and pierced after the manner of the *jali* work in Indo-Saracenic buildings. Such carvings as can be completely separated from the structure will be actually executed by Indian craftsmen in India. The domes and vaults have been designed for painted

decoration for which it is intended to secure the services of specially selected Indian artists. The library will also be decorated in Indian style, and for this purpose some of the beautiful Indian woods will be used instead of stone. Sir Herbert Baker, from his long association with New Delhi, has now considerable knowledge of Indian art and, with his own artistic instincts, he will doubtless arrive at a treatment of the interior of the new India House which will be both beautiful and in accordance with the Indian character desired. But, as regarding the exterior, there has been more difficulty in deciding on the nature of the design in order to give the building an appropriate expression. Despite the desire that the India House should convey the idea of India in London, it was felt that there must be a reasonable degree of harmony with the architectural manner of Aldwych as a whole. An Indian style of structure, however attractive it might be individually and by itself in a detached position, would be hopelessly incongruous in that particular neighbourhood.

It is not sufficient that a building should in itself satisfy the requirements of good architecture; in juxtaposition with other buildings it has to fit in with its surroundings and look at home and at ease, or its appearance will offend the canons of good taste. The spaciousness of planning, with vaulted domed porticos, arcades and colonnades, which is characteristic of the great buildings of India, would be out of the question on a restricted site in the heart of London. Recesses behind arches and columns, too, would give a false architectural expression on a northern façade in the atmosphere of the metropolis of England. Sir Herbert Baker is too great an artist not to realise these difficulties to the full, and he had also to consider that the India House would be the central feature of the whole front from the Gaiety Theatre to the centre of Bush House. In Norman Shaw's design for the Gaiety Theatre, the colonnaded treatment at the corner gives way to a plain elevation which is continued with good architectural judgment over Marconi House, and from the mighty portico in the centre of Bush House the continuation of that building towards the west, which is now in course of construction, is of the simplest possible character. The India House, in order that it may possess a high standard of architectural good manners, must therefore follow the restrained architecture of its immediate neighbours and rely for its effect upon simple well-proportioned fenestration and the continuity of the one great cornice and upon plain wall surfaces which catch the light rather than upon heavy moulding which interferes with light and rapidly collects sooty deposits. Expression of the Indian character of the building will be found mainly in the interior, but the architect has aimed at giving the details of the external elevation by means of carving heraldry and symbolism an individuality proclaiming to all who know the language of Indian art that the House is to be the London home of India. The cost of the work is said to have been estimated at over £300,000, and at that figure Sir Herbert Baker will no doubt produce a structure worthy of its great aims.

A BUSINESS ASPECT OF INDIA.

A LETTER from Sir Willoughby Carey published in "The Near East and India" is so full of sound sense that we reprint it *in extenso* below :—

To the Editor of "The Near East and India."

SIR,—Now that the Statutory Commission appear to be overcoming the initial difficulties of their reception and to be finding, as was to be expected. at least sections of the population of India ready to welcome them and to do their best to help them to come to conclusions, it may not be out of place to put forward one or two considerations which are not in the habit of being loudly voiced, because they concern sections of the population who are generally too busy to expend much time in talking about what they are doing; secondly, because the electoral representation under the original Reforms Act did not give much opportunity for their representation. I refer to the very large numbers of the Indian population who are engaged in industries within the continent and in commerce, both internal and external.

What this means to the country may be in a small measure estimated when one sees that the available figures for 1926-27 were the equivalent of £206,500,000 for companies registered in the country, which does not at all include the enormous amounts involved in the daily import and export trades of firms and private persons, or the probably equally large amount involved in internal trade. Out of this the same official reports inform us that some £80,500,000 is invested in railways and transport. Also, in addition to the figures and facts above mentioned, companies and interests representing £772,750,000 were daily concerned in working in India. All these figures are steadily increasing figures under the present régime set up by Sir Basil Blackett, and one would not wish to see any setback.

Trade cannot be developed unless the nations trading with India retain confidence in the stability of her revenues and financial administration. The central revenues are dependent largely on expansion of trade, because all the interests abovementioned are large contributors to the revenue of India, probably, next to land, the largest contributors. Whatever recommendations, therefore, may in due course be made by the Commission, they should include the complete safeguarding of this side of the country's life. Indian and European interests are both involved and, if anything, Indian interests more largely even than European, enormous though these latter are. The European commercial man has probably tried to work the reforms up to date as loyally as anybody, but he has made no concealment of the fact that, with increasing independence of government, increasing safeguards of revenue and law and order, in his opinion, become necessary.

The opinions were clearly stated before the Lee Commission by the Bengal Chamber of Commerce in the evidence of their witnesses, of whom I was one, and these opinions were supported widely. I am sure that the Indian merchant and industrialist are of the same mind and would not welcome, in the long run, any degree of independent government which did not fully provide for a solvent and well-regulated State, with the essential safeguards to enable them to carry on and improve their trade.

One is perhaps just now forced to these reflections by the untoward fate of the Reserve Bank Bill, recently slaughtered by the Legislative Assembly to provide an extremist holiday, even though it had been admitted by all parties to be a measure valuable to India's future trade. To the wise Indian no state of government, however independent, would be of any satisfaction unless it also provided for the solvency and progression of the State and the Government.—I am, etc.,

Aldwych House, W. C. 2. W. L. CAREY.

The above letter gives not only the most sensible advice, it comes at an appropriate time, in connexion with the recent utterances of Sir Basil Blackett, possibly the best Finance Member the Government of India have ever had. In his last budget statement he took wholesome views of what is necessary in the interests of the material advancement of India, and he said how desirable it was that the large capital expenditure on railways, irrigation, hydro-electric and other public works should be maintained. In the current year the expenditure is expected to be about Rs. 40 crores, the greater part of the money coming from Indian investors. But if that aim at steady progress is to prosper, it behoves political partisans to turn their energies into channels of practical utility and to aid and not embarrass the Government. The great potential wealth of India can be turned into actual wealth by united effort, but no help can come from what Sir Basil Blackett termed the "persistent irresponsibility" of the Legislative Assembly. Public works can only expand if there is also expansion of trade to provide revenues, and trade will not flourish unless, as Sir Willoughby Carey points out, there is a well-regulated State with the essential safeguards.

Notes and Comments.

Sir George Rainy.—Replying to the memorandum submitted by the South India Chamber of Commerce, Sir George declared that there would be a reduction in the railway freight year after year, adding that the wholesale examination of tariff would stereotype it.

Unfiltered Water Supply.—The situation with regard to the supply of unfiltered water in the southern part of Calcutta city has improved of late. The pressure has increased in places and the houses which were formerly getting a scanty supply have not much to complain of now.

Kankinarah Sewerage Scheme.—This new scheme and other allied purposes for which the Government of Bengal sanctioned Rs. 21 lakhs is to be adopted shortly and will be a most up-to-date one, and will cost about Rs. 14½ lakhs. The sewage treatment works will be placed on the east instead of the west of the Eastern Bengal Railway.

The Paterson Engineering Co. (India), Ltd.—We are pleased to learn that the London Office of this well-known firm of Water Purification Specialists (whose local office is at 2, Dalhousie Square) have secured the filter contract for Amsterdam. The plant is to have a capacity of 20 million gallons per day. We hope to give further particulars regarding the contract in a later issue.

Golden Rock Workshops.—Colonel Percy Rothera, the Agent of the South Indian Railway, has issued a *communiqué* regarding this workshops' staff reduction. He has offered a bonus of a twelfth of a month's pay for each month's service, provided it is voluntary resignation. Should resignation not effect the necessary retrenchment of 3,200 the method of retrenchment by election will be adopted.

Chittagong Port.—A powerful dredger, costing about Rs. 16 lakhs, is expected to arrive soon. This will remove sandy *chars* at the mouth of the river Kornafuli so as to admit big steamers from the Bay of Bengal within port limits. With the creation of Chittagong into a major port with effect from 1st April various improvements are being taken in hand. New Commissioners have been elected and the Board will be formed afresh as soon as the Government's nominations are announced.

British Shipping.—The shipbuilding returns issued by Lloyd's Register shows that although at the end of the March quarter there was a reduction in shipping under construction as compared with the December quarter, the present total of 1,440,000 tons is greater by 224,000 tons than the total for the March quarter last year. Of shipping now being built in Britain 228,000 tons are to be registered in the British Dominions and 177,000 tons are intended for sale or for owners abroad. Striking progress is being made in the construction of motorships.

Automatic and Electric Furnaces, Ltd.—This company, whose Elecfurn Works are situated in North Road, Holloway, London, N. 7, have sent us a copy of a Heat Treatment Bulletin, entitled "The Corrosion of Aluminium Alloys and how Corrosion is affected by Heat Treatment" by E. G. Ritchie, D. Sc., A. M. Inst. C. E., A. M. I. Mech. E. This bulletin is a most interesting one. Wild-Barfield Electric Furnaces for the heat treatment of aluminium alloys need no introduction, as they have been frequently alluded to in these columns. The furnaces are in great demand and are being very extensively used in all parts of the world.

Messrs. Roness Limited.—This company, whose works are at Littlehampton, Sussex, England, has sent us particulars of their New Outboard Motor, the only British Twin Outboard, and is made by the manufacturers of the world famous J. A. P. Motor-cycle Engines, in the largest factory of its kind. An Outboard Motor is the Motor-cycle of the Marine World. It is a small engine easily carried about, and may be affixed to the stern of almost any boat quickly and simply and made secure by tightening up the two thumbscrews with the hands. The boat is thus transformed into a motor boat and according to the power of the engine develops a good turn of speed. They are being very extensively used.

Punjab Canals Report.—The following is a summary of the report on the working of the Punjab canals for March 1928 :—*The Southern Administration Canals.*—Except for slight showers in the last week, in the tracts irrigated by the Western Jumna Canal, the Sirhind Canal and the Upper Bari Doab Canal, the weather was dry and temperate. The demand for canal water was keen to moderate, but the supplies in the rivers were not sufficient. *Northern Administration Canals.*—Owing to an increase in temperature and the almost total absence of rainfall, the demand for canal water has been very keen during the month, and, fortunately, the river supplies have been adequate. The condition of the crops is generally good.

Back Bay Scheme.—The dredger damaged owing to an accident, has been condemned by the authorities. New engines have been ordered from Scotland, and on their arrival the dredger will be reconditioned and then offered for sale. The situation at present in the Back Bay Reclamation Scheme is as follows :—The wet filling of Block No. 1 has been completed. The wet filling of Block No. 2 will be undertaken some time in October next. Nos. 3, 4, 5 and 6 have been abandoned. The topping in of Block No. 8 will proceed up to the end of the year, and after it is finished the Moorum-topping of Blocks Nos. 1 and 2 and the Moorum Bund along the Southern boundary of Block No 2 will be taken up. As the last work is the most important of the three, it will be taken in hand first.

Agriculture in Nizam's Dominions.—Dr. Harold Mann after inspecting the lands now under Manjera River Irrigation Scheme and which will later come under the Nizam Sagar Canal Project has proposed to the Government that in view of the immense interest involved in these schemes it is immediately necessary to open an agricultural station near Pocharam, partly for experimental work but to a greater extent for a demonstration of the best way to use water and grow garden crops alternative to rice. He has also submitted several proposals regarding the suitability of black soil lands for wet cultivation and measures to prevent deterioration of lands under irrigation by Mahbub Nanir which are said to be declining in the yield and value consequent on the formation of slimy silt. The proposals are being discussed with the officials concerned.

The Acworth Memorial.—Sir William Acworth, whose name is likely to be long remembered in India for his work on the Acworth Committee appointed to enquire into and make recommendations for the betterment of Indian railway administration, died in 1925, and since then contributions were invited for the purpose of a memorial in his name. It has now been decided that the sum so collected should be devoted to the endowment of a scholarship to be called the Acworth Scholarship. The first award of this scholarship will be made in September 1928, and the subject of the competition will be inland transport, probably railway transport on account of Sir William Acworth's great interest in railways. Everyone will agree that the shape the memorial has taken is a very appropriate one.

Shipbuilding for Canada.—The S. S. "Livingston," the first of the two Canadian Lake steamers built for service on the Great Lakes, the Canals and the River St. Lawrence, ordered by the Mathews Steamship Company in January last from Armstrong, Whitworth and Company was recently launched from the Armstrong yard. The principal dimensions of the vessel are:—Length over all 259½ feet, length between perpendiculars 253 feet, breadth moulded 43½ feet, depth moulded 21½ feet. The vessel is designed to carry 2,350 tons on 14 feet draft. She is built to Lloyd's Class and is of the singledeck type with poop and forecastle. The building of this vessel was a remarkable feat of rapid construction, the keel having been laid on 17th January and the vessel launched within 66 working days, despite delays due to abnormal weather conditions.

Metallization of Aircraft.—It seems probable that military aircraft of the future will be of metal. All-metal flying machines can, it is known, be manufactured with very efficient results, and whether they are in every way better than machines constructed partly of wood or not, they have for war purposes certain advantages. War demands will always be of a fitful kind, and when there is sudden need, standardised metal machines can be manufactured at engineering shops with greater rapidity than the usual machines of the past. Also, should it be necessary to have aircraft in reserve for emergencies, the all-metal machine is likely to deteriorate less in storage than the machine which is partly of wood construction. Granting therefore that efficiency can be secured, all-metal aircraft will be more economical than aircraft of mixed construction.

Hyderabad Railways.—The Nizams Government is spending a considerable amount of money on various railway projects. In the previous year Rs. 69¼ lakhs were budgeted for and in the coming year Rs. 67 lakhs are allotted for the completion of the Kazipett-Ballarshah line and the construction of two feeder lines, namely, Parbhani to Parli, which has been already sanctioned, and Vikarabad to Bidar, which is under survey. A detailed survey was carried out in connection with the last named project, and it is expected that the construction of this line will be soon taken in hand. Vikarabad, which is a health resort, is on the broad-gauge line from Secunderabad to Wadi, and the town of Bidar lies 85 miles north-west of Hyderabad City and is the headquarters of the district of the same name. The line which is estimated to cost Rs. 30,82,174 will be owned by the State.

East Indian Railway.—The budget estimate for gross receipts of this Railway (proper) for 1928-29 has been placed at Rs. 20,75,000 and shows an increase of Rs. 15,000 over the revised estimate for 1927-28. The net increase in 1928-29 as compared with the estimated normal earnings and the total estimated earnings of the year 1927-28, amounts to Rs. 30,000 and 15,000 respectively. An extensive construction programme is provided for during the quinquennial period 1928-29 to 1932-33 as besides the Central Indian Coalfields Railway and Calcutta Chord Railway the construction of the Lucknow-Sultanpur-Jaunpur, the Unao-Madhoganj and the Chandpur-Sian-Bijnor-Muazzampur Narain is in hand, and that of the Anhadpur-Budaon-Chandausi, the Sainthia-Bansi-Baidyanathdham, the Roorkee-Kasganj-Phaphund and Rikhikesh-Karanpravag projects is contemplated. Provision has been made for renewals of 28 engines during 1928-29 and 23 engines during 1929-30, 32 engines during 1930-31, 23 engines during 1931-32 and 23 engines during 1932-33 in order to replace engines which are no longer suitable for traffic.

Water-Works.—"The Water-Supply of Towns and the Construction of Water-Works" by W. K. Burton has appeared in fourth edition, revised by J. E. Dumbleton (Crosby, Lockwood. Two volumes. 25*s.* each.) Sanitary engineering is a branch of the profession in which Mr. Burton practised and in which he was also a University Professor. He is therefore able to speak from what his own practical experience has taught him, in fact that is what he does, and the book is not a compilation of information derived partly from personal experience and partly from other sources. The first volume takes into consideration all the preliminary and general aspects of water-supply projects, the points that have to be studied in the framing of a scheme, the sufficiency and the quality of the water, the quantity per head of population, the methods of estimating and of designing the various works. With that as a basis, the second volume proceeds to all the details of the distribution works, reservoirs, pipes, pumping machinery and the rest. In all these matters the previous editions have now been brought up to date, and the book is a valuable work of reference for sanitary engineers.

Sukkur Barrage.—The official report for the quarter which ended on the 31st December 1927 gives the expenditure incurred on the Sukkur Barrage as over 6¼ crores. During the last working season of 5 months 3¾ million cubic feet of masonry was laid for the head-regulators of 5 of the 7 canals, which is claimed to be a world's record for work of a like nature. Total earthwork completed in the North-Western and Western Circles is 52 crores of cubic feet. The number of units of electric power created during the quarter was nearly 4 lakhs. These figures are published to give an idea of the immensity of the work which the irrigation engineers of Sind are engaged in. The actual figures will appeal to canal engineers only: the layman will take it for granted that the progress is a record, that this is the greatest irrigation work of the world and that the greatest economy is being exercised in the construction. This is comforting after the excesses that have been revealed in revised estimates in Bombay and Punjab works that are also in hand at present, and where large savings by reduction of projected works have not been of much avail in covering enormous all-round excesses.

Indian States Committee.—His Highness the Maharajá of Kashmir gave a State banquet to His Excellency the Governor of Madras and Lady Goschen, His Excellency the Commander-in-Chief and the members of the Butler Committee at Srinagar on the 13th April. Proposing the health of his guests His Highness said that no committee appointed to deal with Indian affairs had been faced with a problem of greater magnitude than that regarding the relations existing between the British Crown and Indian States. They were as vague and ill-defined to-day as they were in the days of Marquis of Hastings. It was therefore not to be wondered at that with the economic and political unification of India coming about so rapidly, the Princes should desire a clear definition of their rights and interests. They felt that decisions had been taken on important matters jointly affecting British India and the Indian States, in which not only had their interests been overlooked but also their position as secured by treaties and solemn pledges, had been seriously affected. He pleaded that their relations with the British Government should be put on a satisfactory basis, and he sincerely hoped that the work of the Committee would result in a great step in that direction. Sir Harcourt Butler replying said he sincerely hoped a solution satisfactory to the British Government and the States would be arrived at by the Committee.

Continued Development in Power Transmission.—Within the past two years the progress achieved in the chain driving field has been extraordinary. Whereas previously the power user, desirous of using chain as a power transmission medium was compelled to enter into a minute specification, the present tendency of the chain manufacturer is to eliminate this tedious necessity for selection by offering a series of drives from stock to meet the normal requirement of industrial lineshaft driving and motor shaft sizes as specified by the most important motor manufacturers. The Renold Stock Drives up to 100 h.-p., which, as their name implies, are available for delivery from stock, and are becoming universally well known. This series of stock drives will not permit of modification and, apart from minor alterations to bore sizes and increased centre distances, the user is required to accept the drive as stocked by the manufacturer. The pioneers of this series of stock drives up to 100 h.-p. have made a further step forward in the direction of progress, and now offer a complete range of Standard Design Drives up to 600 h.-p. which are capable of considerable modification to suit the power user's particular requirement. Like Stock Drives, the Standard Design series cover both Bush Roller and Inverted Tooth types, and the customer is able to make his selection accordingly. A booklet is available giving prices and details as well as prices of this new series, and can be obtained direct from :—Messrs. Hans Renold, Ltd., Burnage Works, Didsbury, Manchester.

A New Motoring Invention.—Perhaps the greatest difference in pre and post-war motoring is that a car is now accepted as a means to an end rather than the end itself. Gone is the enthusiasm that made men spend whole days inside and under "the works." To-day no one wants to see machinery more than they need, and hence the modern car must be easily "valletted" and "vetted." One of the directions in which great progress has been made in simplifying maintenance is in the method of oiling the chassis parts. On the more old-fashioned cars this was done by dozens of grease cups and caps that each had to be screwed and unscrewed and then filled up with grease—an awkward, messy and time-wasting job. Then came the grease gun with a quick attachment to the greaser and some saving in time and trouble. Even this was considered too worrying for the average owner-driver who declared that he must either miss his Saturday afternoon's golf or forget that his car needed its weekly greasing. To make maintenance still simpler a few enterprising makers, led by Armstrong Siddeley, recently decided to break away with an entirely new development that could be operated while the car was in motion. This new central chassis system consists of an oil pump that is operated by the foot and feeds all the chassis bearings with their correct amount of lubricant. By this remarkable invention operations that previously occupied several hours are completed in a few seconds, Saturday afternoons are freed for golf, countless tempers are preserved and hands and clothes are kept clean. In a few years' time no car will be up to date without a similar fitting. As the chassis parts are never neglected with the new system they may be expected to last indefinitely, rattles and squeaks are eliminated and adjustments owing to wear are less frequent.

An Electric Brain.—In these days of super-efficiency and keen competition the businessman must watch his costs with the most meticulous accuracy. By the most searching analyses he must resolve the total into its elementary units and thus discover accurately how much of his expenditure has gone to the production of the finished articles whether in materials, wages or other charges. Only by such means can he ascertain what is the true position of affairs, and, if there are weaknesses, he can find them and take the necessary steps to remedy them. Ordinarily this detail work involves a great deal of clerical labour and time. It is for this very purpose that the electric sorting, counting and tabulating machines, invented by Dr. Hollerith, came into being and became the recognised media for accounting and statistical work. Briefly records of descriptive data are represented by holes punched in cards, the position of which control the electrical mechanism of the machines. Thus, in the case of labour records, for instance, the details of time sheets, etc., originally made out by workmen or shop clerks, are recorded on Hollerith cards in the office by punching holes in the required position. This record card can then be dealt with by the electrical machines, and any dissection such as cost or hours by department, man, separation of piecework and daywork, production of indirect labour jobs, etc., can be obtained as desired. All these details can be collated at the same time giving a tabulated return showing quantity, hours and wages paid. The punched cards are run through the Hollerith machine each week which adds up the amounts recorded thereon, which are agreed with the amount on the pay roll. Having agreed this, any analysis desired with regard to labour cost can be proceeded with in the certain knowledge that the figures dealt with are in agreement with the total amount paid in wages. Once all the details of a transaction have been recorded by punched holes on the card, the original ground never requires to be traversed again. It is only necessary to sort the cards by machine into any order desired and put them through the tabulating machine.

Current News.

MR. R. SCRIVENER, Executive Engineer, East Indian Railway, is permitted to retire.

MR. A. BAYLEY, on return from leave, has taken over charge as Superintendent, Transportation Traffic, B.-N. Railway.

THE headquarters of the 3rd Bahawalpur Circle, Sutlej Valley Project, have been transferred from Simla to Multan.

IT is estimated that the full development of the water power of the Tennessee River will cost one thousand million dollars.

A NEW motor road from Jeddah to Mecca is under construction and a new condenser is being erected by two Scottish engineers.

MR. A. DUNCAN, Superintendent, Transportation Traffic, B.-N. Railway, has proceeded on seven months' combined leave.

MR. JESTON HOMFRAY, Officiating Conservator of Forests, Southern Circle, Bengal, is allowed leave for seven months and fifteen days.

ON return from leave Sir B. Narasinha Sarma, K. C. S. I., resumed charge of the office of President of the Railway Rates Advisory Committee.

THE death occurred on 18th April at the Mines Hospital, Champion Reefs, of Mr. R. J. Irwin, Assistant Chief Mining Agent, Nundydroog Mines.

THE general warehouses of the State Railways at Zemoun, near Belgrade, were destroyed by fire on 18th March owing to an explosion in the petrol stores.

IT is understood that efforts are being made to revive the grand trunk canal scheme which was abandoned by the Government of Bengal some time back.

IT is announced that Yarrow and Co., Ltd., of Scotstoun, propose to establish a shipbuilding yard at St. John, New Brunswick, for the construction of shallow-draught craft.

KING GEORGE'S DOCK, Calcutta, which is estimated to cost 8½ crores of rupees and to cover a total area of 4 square miles, is expected to be completed by 1929. The project was started in 1921.

THE offer of the Power Corporation of Canada of £11,531,000 for the British Columbia electric railway has been accepted. The control of the railway therefore passes from British to Canadian interests.

IT is understood that Mr. H. C. Sparke, Director of Traffic with the Railway Board, has been appointed Railway Member of the Railway Rates Advisory Committee, *vice* Mr. S. D. Manson, on leave out of India.

AT a meeting of the Executive Committee of the Punjab Chamber of Commerce, Mr. P. Mukherji was elected Chairman for the year and Mr. Teasdale, of Messrs. Bird and Co., Lahore, Deputy Chairman.

MR. D. J. COHEN was elected a member of the Board of Trustees for the Improvement of the City of Calcutta, in place of Babu Sailapati Chatterjee, resigned, at the meeting of the Calcutta Corporation, on Wednesday last.

WHEN the bids for the foundations of the Manhattan Tower and anchorage of the new Hudson River Bridge were recently opened it was disclosed that prices ranged between such wide limits as 986,600 dollars and 1,773,425 dollars.

THE widening of Park Street, Calcutta, east of the junction with Wellesley Street, is in progress. The kerb stone of the footpath is being laid down after which the process of cutting down the big trees and the set-back of the telegraph posts will be taken in hand.

A MAGNETIC Wig Wag level-crossing signal was recently placed in service at Whitelaw on the South Gippsland line of the Victorian Government Railways, this installation being the twenty-fourth of this type of automatic protection installed during the past few years.

AN obscure railway station at Voropanovo, in the Province of Stalingrad, southern Volga region, where M. Maxim Gorki, the famous Russian author, once worked as a labourer, was renamed "Gorki" on 29th March, the occasion of the 60th anniversary of the author's birth.

THE Peninsular and Oriental Steam Navigation Company announce that as some Indian friends of the Company have objected to the name Taj Mahal for the P. and O. steamer that is now under construction, the Company have decided that she shall be called the "Viceroy of India."

IT is understood that the Government of India have agreed to the loan of the services of Mr. Pitkeathly, Chief Controller to the Indian Stores Department, to the Ceylon Government, for nine months. His temporary successor will probably be Mr. Kirkhope, the next senior officer of the Department.

A GOOD record was recently set up in the United States when 63 miles of double track railway were completed in ten months. The work involved the excavation of a million cubic yards of rock and four million cubic yards of earth, besides the handling of 10,000 tons of structural steel and the mixing of 100,000 cubic yards of concrete.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

THE KENNEDY FORMULA.

SIR,—With reference to the article on page 138 of your issue dated the 10th March 1928:—

(*a*) For V_0 (twice) *read* $\frac{V_0^2}{C_0^2}$ or $\left(\frac{V_0}{C_0}\right)^2$.

(*b*) For "must" in line 3, *read* "most."

(*c*) For "observes" in line 13, *read* "obscures."

The errors are due either to mistakes in fair-copying draft, or to bad writing, for which I apologise.

I see all the articles reached you on the 30th January. I posted them here for the mail of 12th on the 9th idem. Since then I have read Mr. Farrant's article on V_0 and Kennedy's Formula, and hope he will compare his curves and results to include the P. K. Formula.

Σ. Φ.

2nd April 1928.

Literary Notices.

Aerial Photography.—A comprehensive survey of its practice and development. By Clarence Winchester and F. L. Wills, F. R. P. S., with a foreword by Sir Alan J. Cobham, K. B. E., A. F. C., and introductory notes by Sir Peter Clutterbuck, C. I. E., C. B. E., and Sir Felix J. C. Pole. London: Chapman and Hall, Ltd. 1928. Price, 25*s.* net.

This very informative and comprehensive volume has been published at a time when the subject is receiving great attention, and owing to its thoroughness will be much appreciated and meet with a great reception. The authors in their preface write:—"The advent of the aeroplane opened up a new field for photography, and from the moment when camera and 'plane were used in co-operation it was found that an entirely fresh development of photographic practice had been brought into being. It is with this development that we are concerned in the present volume. The subject has been covered, we hope, in a non-controversial way—at least we have endeavoured so to treat it, for in several of the many branches of aerial photography there are rival schools of thought and sometimes conflicting schools of practice. This is inevitable in all experimental conditions. We have, however, maintained as far as possible a broad and unbiased view of the whole subject recognising the need for tolerance in the hope of presenting to the reader a work unhampered by narrow prejudices but supported by our own experience and the best experience of others. Aerial surveying, a somewhat provocative branch of our subject, has been similarly dealt with; and we have not forgotten that, strictly speaking, the work in Britain might be more accurately described simply as aerial mapping. Aerial survey proper covers operations in unexplored and partly explored regions where maps do not already exist or where they are not to be relied on. Successful aerial surveying depends upon close co-operation with the ground surveyor. That this branch of the aerial photographer's work will widen the scope of aeronautics generally is only just beginning to be acknowledged, although some authorities, notably Mr. C. G. Grey, editor of "The Aeroplane," have long been drumming it into influential but frequently unreceptive quarters. It is to experience and to research that this book is due. We have received help from many sources, official and private in Britain, in European countries generally and in the United States of America. We have encountered many difficulties, but on the whole we have met with generous encouragement and practical assistance." The volume is a very bulky one and is richly illustrated throughout. All connected with its outturn are to be congratulated on the success of their work, which is excellent in every way.

CORPORATION OF CALCUTTA.

Appointment of District Engineer.

APPLICATIONS are invited for the post of **District Engineer** and will be received by the Chief Engineer up to Thursday, the 10th May 1928. The salary of the appointment is Rs. **500** rising by annual increments of Rs. **25** to Rs. **750** for approved services. The person appointed will be required to keep a motor car for Corporation works for the upkeep of which he will be paid an allowance of Rs. **100** per month.

Candidates must be qualified in one of the manners following, that is to say, he must—

(a) be at the time of seeking the employment, or have previously been a member of the permanent establishment of the Public Works Department of Government in the grade of Executive Engineer or Assistant Engineer, or

(b) hold the degree of Bachelor of Engineering or be a Licentiate of Engineering of the Calcutta University or have passed the final examination of the Engineering Department of Civil Engineering College at Sibpur, of the Thomason College at Roorkee, of the Poona College of Science, or of some other similar institution in India, or

(c) have passed satisfactorily through the whole course of instruction at a recognised school of Engineering including the final examination, in the United Kingdom, or

(d) be a corporate member of the Institution of Civil Engineers, London.

The selected candidate will be required to reside in the District to which he may be appointed and to conform to the Corporation Provident Fund, Leave and other service rules. He will be given such house allowance as is decided by the Corporation until he is provided with quarters and as soon as he is provided with quarters, he will have to pay rent at such rate as is fixed by the Corporation.

Candidates should give particulars of age, educational and other qualifications and experience and should state if they are related by blood relationship to or closely connected by marriage with the Mayor or any Alderman or Councillor or any Statutory Officer of the Corporation.

Central Municipal Office,
Dated CALCUTTA,
The *19th April 1928.*

BHASKAR MUKHERJI, B. A. (CANTAB.), B. Sc. (CAL.),
Offg. Secretary to the Corporation.

Public Works Department, Central Provinces.

NOTICE CALLING FOR TENDERS.

SEALED TENDERS are invited and will be received at the Office of the undersigned, at Jubbulpore, C. P., up to the noon of Thursday, the 31st May 1928, for the construction of a Submerged Masonry Bridge on the Nerbudda River, at Tilwaraghat, to serve the Great Northern Road, connecting Jubbulpore with Nagpur in the Central Provinces. Time allowed for completion of work—2 years.

2. Copies of the Geological Cross Section of the Nerbudda River at the bridge site, showing the nature of the soils in the bed, can be obtained from the undersigned, on payment of Re. **1** for each copy.

3. Tenderers can submit their own designs for this Submerged Bridge, which may be designed as a masonry structure, with stone or reinforced cement concrete arches.

4. Tenderers are expected to satisfy themselves with regard to the nature and amount of work involved in the foundations and of the nature and quality of building materials available within reasonable leads by a local inspection of the site, before tenders are sent in.

5. Tenders may be in Form F-2 or in Lump Sum Tender Form. Blank copies of such Tender Forms can be obtained by application either to the undersigned or to the Executive Engineer, Jubbulpore Division.

6. Specifications and plans of the work as framed by the undersigned can be inspected and any particulars ascertained from the undersigned, during office hours.

7. Earnest money required with the tenders is Rs. **500** (five hundred), which should be deposited with the Executive Engineer, Jubbulpore Division. It will be returned to unsuccessful bidders on the rejection of their tenders and will be retained in the case of the successful competitor, as part of the security deposit, mentioned in paragraph 8. A certified copy of the Executive Engineer's receipt of the earnest money should be attached to the Tender.

8. The security taken for the due performance of the Contract under the terms and conditions printed on the Tender Forms will be the earnest money plus a deduction of Rs. **10** per cent. from payments to be made for work done.

9. The Contract must not be sub-let.

10. The tenders will be opened at the time and place, stated in paragraph 1 by the undersigned.

11. The undersigned does not bind himself to accept or to recommend to the Chief Engineer, Central Provinces, for acceptance, the lowest or any tender.

B. C. DUBE,
SUPERINTENDING ENGINEER,
Second Circle, P. W. D., Jubbulpore, C. P.

Dated JUBBULPORE,
The *19th April 1928.*

Foreign Notes.

Iron and Steel in Mexico.—The most important iron and steel works in Mexico is situated at Monterrey, the fourth largest city in Mexico and an important railway junction, not more than 100 miles from Laredo on the United States border. The iron ore is from the famous Iron Mountain, known as the Cerro del Mercado, near Durango. Although the Monterrey Company is an active concern, it is some years since the volume of business came up to expectations. During 1926 the blast furnaces produced some 60,000 tons of pig-iron. The steel output was of 78,000 tons and the rolling mills turned out about 32,500 tons of heavy steel rails, joists, channels, angles and bars. The Company has started to produce ferro-manganese, and it is understood that the results have been satisfactory.

Electric Arc Welding.—In a paper read before the Boston Society of Civil Engineers, Mr. C. W. Babcock described how the worn cast-iron casing of a water wheel, 6 feet in diameter, was mended by electric arc welding. The patching had to be built up to a depth of about 1 inch and was started by welding in place a number of steel hoops from ½ inch to ¾ inch in diameter. The remaining space was then filled in by welding. While welding directly on the cast-iron the welder ran a bead of only 1 inch or 2 inches at a time on one spot, and a helper then immediately peened this with a hammer to stretch it and avoid porosity as much as possible. The first layer of welding to the cast-iron was done with a special grade of welding wire for cast-iron. Succeeding layers were put on with ordinary steel welding wire. After the welding operation was finished a portable grinding wheel was rigged up and the high spots ground off the welded section.

Exploitation of Yampi Iron Deposits.—There are good prospects of the extensive deposits of rich iron ore at Yampi Sound, in Western Australia, being worked with British capital at an early date. Negotiations for the shipment of 150,000 tons of ore annually to Japan are proceeding between Japanese interests and the holder of the option over the Koolan Island leases in the Sound. The leases are held by a Western Australian syndicate, from which Mr. J. Thomson, who formerly held leases of the Cockatoo Island deposits in the same Sound, has obtained an option. Should a deal result, it is understood that capital will be found by a group of British ironmasters to install the necessary plant and equipment for the quarrying and shipment of ore. Mr. Thomson disposed of the Cockatoo Island leases to the Queensland Government some years ago. Since then the Queensland Government has sold the leases to an Australian firm, who propose to commence work at the island on a large scale in the near future. It is understood that a representative of Japanese interest is negotiating for the purchase of Koolan Island ore, and is on his way to Western Australia to enter into an agreement with Mr. Thomson.

Hydro-electric Installations in France.—The granting of a concession for the construction of four power stations on that portion of the Dordogne lying between the first section exploited by the Paris-Orleans Railway Company and the town of Argentat marks a further stage in the complete utilisation of the hydraulic resources of that river, which, according to the Ministry of Public Works, is capable of producing 2,000 million kilowatt-hours a year. On the first section the Coindre and Roche-le-Peyroux stations have been completed, and two other installations at Chavanon and Morèges are to be put in hand. The original concession provided for three barrages of 109 m., 46 m., and 9 m., but it has been found more economical to replace the biggest barrage by two dams, one of 87 m. and another of 40 m., and work will be started upon the 87 m. barrage at Aigle. It is estimated that the cost of the current produced will be a little less than 6 centimes per kilowatt-hour. The concession has been accorded to the XVII. Groupement Régional des Chambres de Commerce, which undertakes to form a company to carry out the work with the aid principally of manufacturers and other users. The State will give assistance by supplying material obtained from Germany on account of reparations, and will receive shares in proportion to the material thus furnished.

Articulated Carriages in Argentina.—The Central Argentine Railway has recently introduced articulated cars on the express trains running between Buenos Aires and Rosario—the fastest service in South America, says the "Railway Gazette." This is claimed to be an innovation in Argentina, and it is stated that the new vehicles are the longest and heaviest so far built on the articulated principle. Six-wheeled bogies are adopted at the articulated joint. The twin cars comprise a first-class unit and a kitchen and restaurant unit. Extreme length over buffers is 135 feet 10 inches, centres of bogies for each unit being 55 feet apart. The total height of the vehicles from rail level is 13 feet 3¾ inches and the width over body 10 feet 4¾ inches. Owing to the increased dimensions and weights a special design was made for the articulated pivoting and side friction bearings, fitted with strong safety chains. The whole of the underframe and bogies were built in England, but the carriage bodies were constructed in the Central Argentine Railway Workshops at Rosario. To meet the requirements of a recent Government decree steam-heating apparatus has been installed. It is stated that the articulated principle was introduced partly in the nature of an experiment; that the results so far obtained have fully realised expectations; and it is probable that, in consequence, the use of the articulated principle will be extended.

Railway Re-location in Peru.—According to the "Railway Gazette," owing to constant trouble from severe avalanches, and to the difficulty of retaining labour in a fever-breeding district, that section of the Central Railway of Peru which runs through the Purhuay Valley has had to be re-located. The line, which is standard gauge, is owned by the Peruvian Government and operated by the Peruvian Corporation. It has a continuously ascending gradient for nearly 107 miles from sea level at Callao to the summit at 15,806 feet. In spite of a reinforced-concrete shed built after previous avalanches, an unprecedentedly heavy avalanche in 1925 partly destroyed the line. The original location involved two crossings of the Rimac River. The re-location decided upon confines the line to one side of the river, but has entailed the driving of a tunnel through the solid rock 1,640 feet in length on a 3 per cent. gradient, and about 3 miles of heavy constructional work. As this required some time, a temporary line on a 5 per cent. gradient and a 62 feet bridge had to be built to carry the traffic meanwhile. The erection of the bridge proved a difficult task in a river subject to heavy floods. It was, however, successfully completed in December 1925, and the construction of the tunnel, and of the new line, was finished and the line opened in the autumn of 1926. The work was carried out under the direction of Mr. F. F. Hixson, the Chief Engineer of the Central Railway, and mainly with railway forces.

Lightning Protection of Oil Reservoirs.—The need for protecting large oil-storage reservoirs from lightning has been recognised for some time, and was emphasised by the number of disastrous oil fires which broke out in California during 1926. At the request of the oil companies, Mr. F. W. Peek made a series of tests with model oil reservoirs, on the basis that there is a risk both from induced voltages and direct strokes. As a result, he recommended the use of all-metal tanks, the walls of which must be sufficiently thick to provide ample conduction of currents from direct strokes and in good contact at all points to prevent sparking. Where the reservoir could not be made of metal, the use of conducting poles, in combination with a well-banded metal roof or wire cage, to which all neighbouring metal should be connected was suggested. By replacing the air in the space above the oil by an inert gas, an additional protection against secondary discharges is provided. In an article by Mr. J. T. Lusignan in the "Electrical World" of 15th October 1927, it is stated that this system has been adopted in California by the Shell, Associated and Union Oil companies. The effective height of the poles is 136 feet. The cage is 14 feet above the surface of the reservoir and is connected to an earth wire buried in a trench round the reservoir. Another system of protection, which has been developed by Mr. J. M. Cage, of Los Angeles, is based on the principle of equalising the charge between the cloud and earth as rapidly as it is formed. Horizontal wires, provided with barbs, are used, and are stretched so that they are as nearly level as possible. They are carried on steel towers from 80 to 95 feet high, and spaced from 300 to 400 feet apart. At each tower an earth connection is made to water-bearing strata.

The Chambon-Romanche Barrage.—The recent communication of Monsieur Mesnager to the Académie des Sciences to the effect that solid barrages are constructed with bases of insufficient thickness and are therefore a constant menace to the public safety, has evidently aroused some feeling of uneasiness, for at the instigation of the Chamber of Commerce of Grenoble Monsieur Haegelen, chief engineer of the hydraulic services, held a conference recently concerning the dam which is to be constructed at Chambon on the Romanche. He declared that there was no ground for the criticism that existing barrages did not provide for exceptional pressures. The Perrégaux barrage in North Africa failed because hydraulic engineers knew nothing at the time it was constructed about the hydraulic conditions of that country. For thirty years there had been no instance of a barrage giving way in France. Monsieur Haegelen then gave details of the Chambon barrage which is to be constructed on the Upper Romanche. It will create a reservoir having a capacity of 50 million cubic metres, and between its level and that at the junction of the Drac and the Isère—a difference of about 800 m.—the total amount of energy available will be 110 million k.w.h. a year. The Chambon barrage will have a height of 88 m. above the bed of the river and its thickness at the base will be 56·25 m. It will be of triangular section, except at the base, where it will form a kind of wedge in a narrow gorge. The sluices are arranged to provide for an emergency discharge up to 400 cubic metres a second, that being necessary to provide for military requirements in the event of the reservoir having to be emptied, and, as it represents five or six times the maximum flow observed during the past twenty years, there can, it is affirmed, be no risk of undue pressure on the barrage. In its construction 250,000 cubic metres of concrete will be employed. The lake thus created will cover 350 acres and will submerge three villages and a part of the road between Grenoble and Briançon.

Electric Power by Radio Beam.—According to Mr. Phillips Thomas, research engineer to the Westinghouse Electric and Manufacturing Co., if we could generate a wave of ten centimetres wave-length, we could reflect it exactly as we do light beams, and if we had a means of concentrating power in a reasonable amount in that beam—say a few thousand watts—it is quite within reason to expect that the air in the path would become ionised and be quite a fair conductor for electricity. We should then have the equivalent of a small copper wire, except that it would have no weight. It could be aimed at any desired point, without allowing for range. Two such beams, along parallel paths, could have their reflectors connected to the high-voltage terminals of a transformer, when a current would flow between the distant ends of the beams. If the two targets were metal plates connected to a transformer arranged to step-down the voltage, power could be developed at the receiving end. The power to be sent would not have any necessary relation to the size of the apparatus at the sending end, so that once we had the ionised paths, the power sent along them could be many times that required to ionise them. This power could be used to great advantage in cases where power was required in locations where the difficulty or expense of stringing wires would prohibit its delivery in the usual way. Such an apparatus, besides its peace-time uses, would be of tremendous value in war-time, because it would be fatal to life to come into the path of the rays when energised at high voltage; in other words, it would constitute the "death ray" which has received so much attention from inventors. All this, he says, is quite feasible on one supposition, namely, that we have the ten-centimetre wave, with the necessary radio power behind it. This supposition is at present impossible of realisation, due to the limitations of vacuum tubes of the standard type. It is not, however, nearly as large a step from the present tubes to tubes of a proper type, as it was from no tubes to the present type. In fact, a type has been worked out on paper, and is soon to be tried out experimentally, which bids fair to give exactly what is required. Much more difficult things have been done, and Mr. Thomas predicts that this, in turn, will before very long be an accomplished thing.

General Articles.

ELECTRIC EXPRESS LOCOMOTIVE, G. I. P. RAILWAY.

By the courtesy of the British Brown-Boveri Limited the "Railway Gazette" is enabled to reproduce a sectional elevation and part plan drawing and photographs of a new electric express passenger locomotive for the Great Indian Peninsula Railway, which has just been completed at the works of R. and W. Hawthorn Leslie and Co., Ltd., Newcastle-on-Tyne. This latter firm have constructed the structural and mechanical portions, and the Brown, Boveri Co., Ltd., of Baden, Switzerland, the electrical portions. We are indebted to our contemporary for the illustrations on the opposite page and for descriptive letter-press.

The locomotive, which was on view recently at the works in Newcastle, has been designed as a typical express passenger locomotive, having the "2-A-A-A-2" wheel arrangement, the equivalent of the 4-6-4, but with uncoupled driving wheels. The three driving axles incorporate the Brown-Boveri individual axle drive. There are six main motors, *i. e.*, two to each driving axle connected permanently in series. The three motor groups are arranged to be connected in series, series-parallel, and parallel for starting the locomotive and for regulating its speeds. Altogether, there are nine economical speeds, including the two field weakening positions, and the locomotive can be run continously at all of these positions.

The driving motor circuit operates at 1,400 volts, and the auxiliary motor circuits, such as those for the blower, compressor, exhauster and converter motors, as well as the circuits for the measuring instruments, also operate at the same pressure. The auxiliary circuits for the control and lighting are at low pressure, *viz.*, 50 volts, which is obtained from the generator of the converter referred to above and the battery. The locomotive is not arranged for multiple unit control nor for electric braking.

The main particulars are as follows:—

Rail gauge ...	...	5 ft. 6 in.
Minimum radius of curves	..	500 ft.
Maximum gradient	...	2·7 per cent.
Sections: Bombay-Igatpuri	...	83·5 miles.
Bombay-Poona	...	118 „
System of supply	...	D.C.
Pressure at contact wire ..	...	1,100-1,700 volts.
Minimum (exceptional)	...	700 volts.
Average	...	1,400 „
Height of contact line above rail—		
Maximum	..	20 ft. 6 in.
Minimum ...	...	14 „ 10 „
Admissible load per driving axle	...	20 tons.
Locomotive weights—		
Mechanical portion, including drives	about	70 tons 18 cwt. 2 qr.
Electrical equipment—		
6 motors...	about	23 „ 15 „ 1 „
2 current collectors	...	1 „ 3 „ 3 „
Apparatus and miscellaneous	...	15 „ 4 „ 0 „
Total weight of locomotive	...	111 „ 1 „ 2 „
Adhesive weight	...	57 tons 13 cwt.
Total length over buffers	...	56 ft. 2¼ in.
Rigid wheelbase	...	15 ft.
Wheelbase of bogies	...	9 ft.
Diameter of driving wheels	...	5 ft. 9 in.
Diameter of leading wheels	...	3 ft.
Number of traction motors (2 motors permanently in series).		6
Type of locomotive motor	...	GLM 65 a 35.
Ratio of gearing	...	1 : 3,237
1-hour rating per motor—		
Motor shaft	...	297 kW.=405 H.P.
Terminal voltage	...	1,400/2 volts.
Speed	...	560 r.p.m.
Current	...	460 amps.
Continuous rating per motor—		
Motor shaft	...	233 kW.=315 H.P.
Terminal voltage	...	1,400/2 volts.
Speed	...	615 r.p.m.
Current	...	360 amps.

Cooling of the motors is effected by means of separate motor blowers and self-cooling by fans mounted on the motor armatures. The "Railway Gazette" is able to give particulars of the contract conditions relating to the performance of the locomotive, the figures being based on measurement at the wheel rim. They are as follow:—

	Pressure Volts.	Tractive Effort.	Speed.	Field.
(1) For starting of trains	1,400	24,000 lb.	36 miles.	Full.
(2) Each locomotive must develop at ...	1,400	6,300 lb.	70 m.p.h.	Weak.
(3) Max. locomotive speed in service ...	—	—	75 m.p.h.	—
(4) Max. speed for which locomotive has been designed ...	—	—	85 m.p.h.	—
(5) For satisfactory operation of train assisted by freight locomotives on Bhore Ghat section. ...	1,400	16,000 lb.	26 m.p.h.	

(6) Starting from rest for a train of 450 + 111 tons on 10 per cent. gradient, 10 times at 5-minute intervals up to a speed of 36 m.p.h. = 58 km.p.h. (Temperature rise of resistance not to exceed 210° C.)

(7) When starting under 6, the tractive effort for each pair of driving wheels must not vary more than ± 10 per cent. of the medium value, which shall be, approximately, 24,000 lb.

The brake equipment provides air brakes for the locomotive, vacuum brakes for the train, and, in addition, a hand-brake on the locomotive.

This is one of the largest and most interesting electric locomotives lately built in this country, and data from its performance in India will doubtless provide some interesting results.

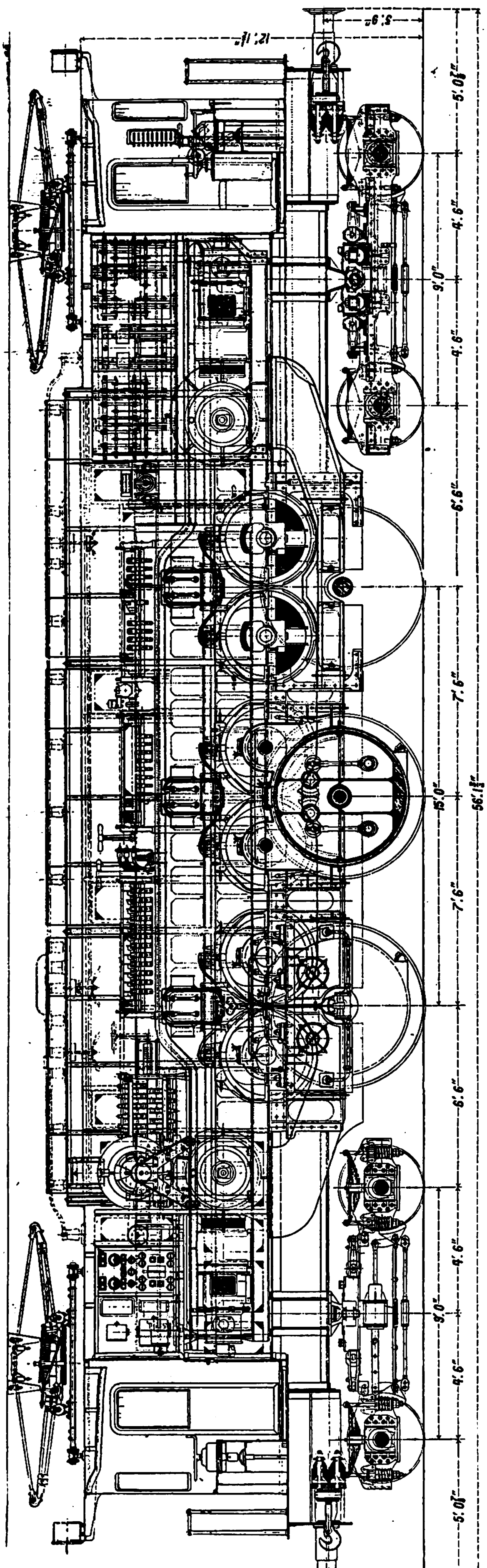
THE PROGRESS OF THE NON-FERROUS METAL INDUSTRY.

A VISIT TO THE METALS SECTION AT THE BRITISH INDUSTRIES FAIR, BIRMINGHAM.

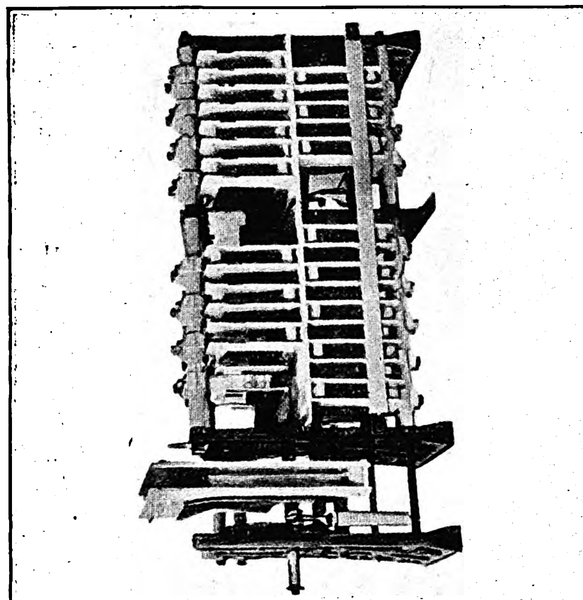
If only those gloomy pessimists who are constantly croaking about the decline in enterprise of the British manufacturer, could but have looked round the Fair held at Castle Bromwich, near Birmingham, they would, indeed, have proved it hard to substantiate their melancholy forebodings.

As is well known, Birmingham and the surrounding districts are the centre of the non-ferrous metal industry, and it was therefore not surprising to find in the Fair exhibits of non-ferrous metals in every conceivable shape and form. What, however, does astonish even those who know the trade well, is the immense variety of different metals and alloys that one firm alone manufactures so as to meet every imaginable requirement. For instance, not only does the Delta Metal Co., Ltd., manufacture a special variety of brass for high-speed repetition work, but the quality of such brass is varied so as to give the best possible results with each particular kind of machine used. It is no wonder then that screw makers and those engaged in similar trades find that by employing "Delta" or "Dixtrudo" brass they can obtain a higher rate of production, and consequently lower costs than when using brass of other make. Each specialised industry finds that an alloy adapted to meet its own peculiar requirements can be obtained from this firm.

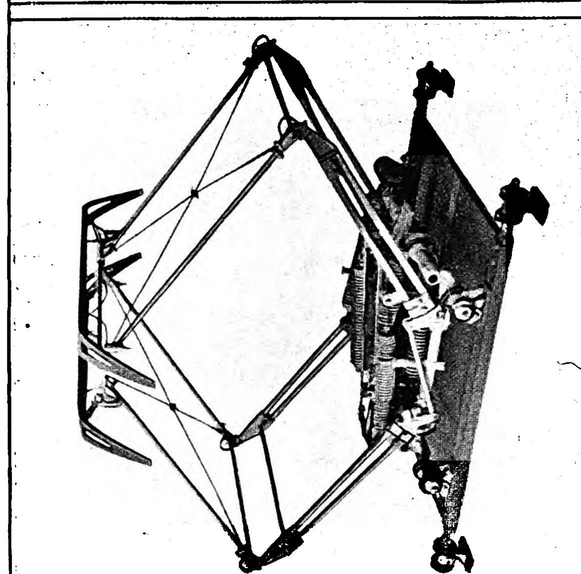
This firm also provided the really beautiful pavilion which at once attracted visitors to that part of the Fair. The pavilion was made entirely of glass and "Delta" bronzes. These bronzes are legion, differing largely in characteristics, colour and composition, but, of course, have this one thing in common, that they are all the produce of the Delta Metal Co., Ltd. The pavilion was some 12 feet long by 6 feet broad by 9 feet high, and was made by the Crittall Manufacturing Co., Ltd., from metal supplied by the Delta Co., "Delta" Bronze No. IV. being the metal principally used for this artistic structure. This bronze is well known throughout the world on account of its great strength, resistance to corrosion and the beauty of its colour both natural and when "weathered."



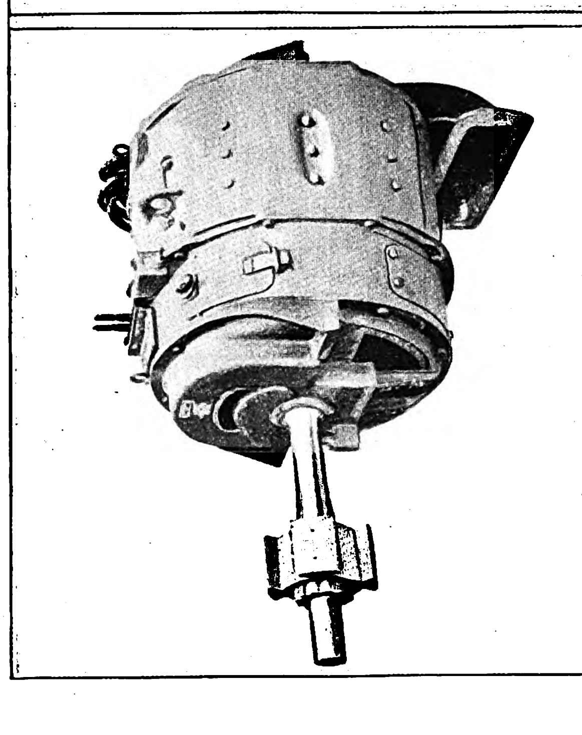
Sectional Elevation, showing Detailed Arrangement of New Electric Express Passenger Locomotive.



Part of the Main Controller.



Pantograph.



One of the Main Motors.

ELECTRIC EXPRESS LOCOMOTIVE, G. I. P. RAILWAY.

Portions of the ornamental work were executed in "Delta" silver bronze and other "Delta" Brand metals. In passing, it may be mentioned, that the former is found to be a great improvement on plated metal work, as the fine silver colour runs right through it, while with plated metal it is quickly worn off.

On stand No. 18A were also to be seen show cases made in one or other of the "Delta" bronzes, large and small forgings and stampings in these and other alloys, together with a greater variety of sections and other specimens of extruded work than anywhere else. This is not surprising in view of the fact that the exhibitors are the pioneers and original patentees of the process, and probably manufacture far more extruded rods and sections than any other firm in the world. Samples of these rods, sections and tubes in all sizes and shapes were shown in brass and bronzes of great variation, yellow metal, naval brass, manganese bronze, copper both of high conductivity and firebox quality, stamping metals in various qualities, white metal, silver bronze, etc. There were test pieces showing the extraordinary tenacity and ductility of certain of the Delta Bronzes, notably Delta Bronze No. 1 with a 50 tons tensile strength, and Delta Bronze IV. E., an alloy specially designed for aircraft and similar work where sudden rupture of a vital part would be calamitous. Other samples illustrated the unsurpassed stamping qualities of "Dixtampo" Yellow Metal. It is surprising that copper flats made by the old rolling process are now ever used in view of the wonderful finish that can be secured by employing those made by extrusion, *i. e.*, "Delta" copper flats.

A description of the Metal Section of the Fair would not be complete without a reference to the exhibit by Messrs. Heaton and Dugard, of plain and fancy wire, beading, chains and hooks, etc.

THE UNIVERSAL P. K. FORMULA.

II.

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It is necessary to concentrate on the 4 references which are co-ordinated in two pairs, see table C. The following table opens the way. [For logs C see table A.]

TABLE D.

Ref. No.	Logs.					Log Diff. in $\sqrt{AQ}$ and $\sqrt{AN}$; and C.*
	ST to 1305.	$\sqrt{AQ_0}$	$\sqrt{AQ_1}$	$\sqrt{AN_1}$	$\sqrt{AN_0}$	
1301	9·730419	1·948224	2·208381	2·004302	2·152304	+ ·056078
1302	9·817601	1·979761	2·121199	2·004302	2·096658	+ ·024541
1303	9·871692	1·985636	2·067108	2·004302	2·048442	+ ·018666
1304	9·904780	2·004465	2·034020	2·004302	2·034184	− ·000163
1305	9·934498	2·004302	2·004302	2·004302	2·004302	....
1306	9·955653	2·012835	1·983147	1·991680	2·004302	− ·008533
1307	9·974929	2·014389	1·963871	1·973958	2·004302	− ·010087
1308	9·991081	2·016296	1·947719	1·959713	2·004302	− ·011994
1309	·005023	2·019692	1·933777	1·949168	2·004302	− ·015390
1310	·018123	2·019299	1·920677	1·935675	2·004302	− ·014997
1311	·029175	2·021145	1·909625	1·926468	2·004302	− ·016843
1312	·039069	2·022702	1·899731	1·918132	2·0043C2	− ·018400

* C of Table A, the original observations.

In the above table all the values of v = ST possess the same C in the equation $v = C\sqrt{m}$, and log C = 0·117764, making C = (nearly) 1·3115, a constant. The reader will notice, see Fig. 1, that for Ref. No. 1305, the standard, the "pair" of parabolas, are the same parabola taken twice, and $S_1 T_1 = S_1 L_1$. In Refs. Nos. 1301 to 1304, Ref. No. 1305 is the outer parabola; in Refs. Nos. 1306 to 1312, Ref. No. 1305 is the inner parabola. It is a geometrical=*cum*-mathematical artifice which has very important results.

What has been done with ST can be done with all the 12 observations. For example, let $C_0 D_0 = v$ = 3·34 feet of Ref. No. 1301, and $C_1 D_1 = v$ = 6·08 feet of Ref. No. 1305. Let AY be the constant l observed for the same two observations. Let $C_1 D_1$ cut the inner parabola in D_2, making $C_1 D_2$ a new v with AY_2 as the new l. We can readily calculate the new values for all 12 observations (No. 1305 is unchanged), by the equation $\sqrt{AC}\ \sqrt{AY} = \sqrt{AS}\ \sqrt{AN}$; the $\sqrt{AC}$ being a constant throughout, the log of which = 0·666139. We shall find also that every one of the new v has the same C, in the equation $v = C\sqrt{m}$ and that this C is the C of Ref. No. 1305, = 9·2719 the log of which is 0·967170.

TABLE E.

Ref. No.	Logs. New v	Logs. $\sqrt{AY_2}$	Logs. $\sqrt{f}$	Ref. No.	Logs. New v	Logs. $\sqrt{AY_2}$	Logs. $\sqrt{f}$
1301	·579825	1·098818	·225916	1307	·824335	1·164984	·196946
1302	·667007	1·130356	·219382	1308	·840487	1·166891	·193371
1303	·721098	1·136231	·213638	1309	·854429	1·170288	·190015
1304	·754186	1·155061	·209250	1310	·867529	1·169895	·186605
1305	·783904	1·154897	·204595	1311	·878581	1·171740	·183518
1306	·805059	1·163430	·200813	1312	·888475	1·173298	·180581

Before proceeding further, the practical hydraulic engineer is asked to note that all the above values of the $\sqrt{AY_2}$, that is, of the new $\sqrt{l}$ to the new v, are based on the sections of channels as stated in table A. Attention is then invited to table B; and the following :—

(*i*) The y-units in the wetted perimeters of the 12 channels observed are $x+6$, and vary in number from about 106·1 to about 25·6.

(*ii*) With the same m to standardized and similar sections, the y-units in the wetted perimeters are a constant 41·442, but the depths, and consequently the y-units, vary in the proportion of d^1 and d (calculated).

(*iii*) In the observed channels, f is a wide variable; in (*ii*) it is a constant.

Accustomed to employ some form of Kennedy Formula, how would the practical canal engineer expect these differing channels to act?

[To add to the writer's difficulties, it is not at all certain that the data of each of the 12 observations is *absolutely* correct.]

Mr. Barnes believes that m and i when equal in value give the same v irrespective of size of channel in the like conditions of flow. [But may not the *shape* of a section, especially when f cannot alter, make a difference in i or l?]

Darcy and Bazin in Set 24 (1865) made similar observations with a semi-circular channel, slope 1 in 666·67, log $\sqrt{l} =$ 1·411954. The Refs. given below are compared in pairs, each pair to a common ST; with the m amended as shown, for Refs. Nos. 1314, 1321, and 1324.

TABLE F.

Ref. No.	Obs. m	Assumed m	Logs $\sqrt{m}$	Logs $2m$	Logs $\sqrt{l_0}$	Logs ST $2\sqrt{m_1}\sqrt{m_0}$	Logs $\frac{\sqrt{AQ_0}}{\sqrt{AQ_1}}$
(1) 1304	·375	·375	9·787016	9·875061	2·034184	9·904780	2·004465
1305	·430	·430	9·816734	9·934498	2·004302	9·904780	2·034020
(2) 1309	·595	·595	9·887259	·075547	1·949168	·088648	1·936067
1310	·632	632	9·900359	·101747	1·935675	·088648	1·948774
(3) 1302	·251	·251	9·699837	9·700704	2·096658	9·851219	1·946143
1314	·503	·502	9·850352	·001734	1·980763	9·851219	2·131278
(4) 1304	·375	·375	9·787016	9·875061	2·034184	·025577	1·883668
1317	750	·750	9·937531	·176091	1·923392	·025577	2·073906
(5) 1306	·474	·474	9·837889	9·976808	1·991680	·127323	1·841165
1321	·949	948	9·988404	·277838	1·893784	·127323	2·044299
(6) 1307	·518	·518	9·857165	·015360	1·973958	·165875	1·823443
1324	1·034	1·036	·007680	·316390	1·881605	·165875	2·032120

The limitations of the statement made at the end of article I are indicated in the first two pairs of observations. Very trifling changes in the m would bring about the equality claimed.

The next four pairs of observations are of deep interest. [Their connection (see Fig. 2) with the granite boss in the Ante-chamber of the Great Pyramid is obvious.] It is necessary to consider the

log differences, saving space by a table, and ensuring clear explanation.

TABLE G.

Pair No.	Log Diffs.			
	$\sqrt{m}$	$2m$	$\sqrt{l_0}$	$\sqrt{AQ}$
3	·150515	·301030	·115895	·185135
4	·150515	·301030	·110792	·190238
5	·150515	·301030	·097896	·203134
6	·150515	·301030	·092353	·208677

In each pair, log diff. $\sqrt{l_0}$ + log diff. $\sqrt{AQ}$ = log 2 = 0·301030.

The Pyramid method is therefore plain. For its accuracy it depends wholly upon the strictly scientific principle of accurate observation; and the method is therefore entirely scientific. In references Nos. 1301 to 1324 we possess 24 observations, with m ranging from 0·168 to 1·034. By halving and doubling every one of these it is possible to interpolate 48 other deduced $\sqrt{l_0}$ and $\sqrt{AQ}$, and having checked the accuracy of these, to continue the process indefinitely.

Σ. Φ.

January to March 1928.
Re-written: 22nd March 1928.

(To be continued.)

ALL ABOUT PIG IRON.

We have recently had the opportunity of perusing an interesting little booklet published by the Staveley Coal and Iron Co., Ltd., of Chesterfield, England, dealing with the various grades of pig iron as manufactured by this up-to-date and progressive firm. The first few pages give briefly the many activities, and various productions of the Staveley Company, and comprise chemical manufactures on a large and comprehensive scale. As a matter of fact the company's chemical plant is the largest in England in conjunction with a blast furnace and coke oven plant.

The output of chemicals are, to mention but a few of a long and varied list, sulphate of ammonia, and muriate of ammonia, pitch, creosote oil, green oil, carbolic acid, pyridine, anthracene, naphthalene, refined tar, benzole, toluole, solvent naphtha, heavy naphtha, aniline oil and salt, disinfectant powder, sulphuric acid (B. O. V.) and sulphuric acid (D. O. V.), accumulator acid, pure sulphuric acid, oleum (fuming sulphuric acid), nitric acid, soda products, such as bleaching powder, caustic soda, sodium hypochlorite, soda crystals, etc. Oxide of iron for gas purification, Wormite, a soil fumigant and insect destroyer, Staveho, a waterproofing powder for cement, but as this particular booklet deals with pig iron alone in detail we may venture to leave this part, but the list above at least gives some idea of the vast scope of the productions of this large organisation.

The next few pages give a short history of the Staveley Company, and if length of experience is anything to go by, then Staveley pig iron should rank high, as the company was formed as far back as 1864, though according to the figures given, blast furnaces must have been in existence on this site for several centuries, as a photographic reproduction is shown of an old account in connection with "Staveley Blast Furnaces," dated 1702. The antiquity of the past centuries does not, however, reflect itself in the present plant as the blast furnaces are as up-to-date and modern as any in England.

Two pages of "notes from the earlier history of cast iron" follow which contain many interesting statements.

This brings us to the pages showing in detail the various grades of pig iron, and as these will no doubt be of interest, we give as follows a list showing the different classes:—

Grade No. 1 Iron.—An open grain, soft grey foundry pig iron. This iron is recommended for the production of thin section castings. It will carry a large percentage of scrap—say up to 50 per cent., or can in preference be used as a softener in conjunction with the harder and closer grades.

Grade No. 2 Iron.—A similar iron to No. 1 Grade, but of a slightly closer grain. This iron is suitable for the production of light castings of somewhat thicker section than castings from No. 1. This iron may be mixed on similar lines as suggested for No. 1 Grade.

Grade No. 3 Iron.—The grain of this grade is closer than that of No. 1 or No. 2, the graphitic carbon flakes not being so prominent. It is recommended for general castings of a heavier nature than previously mentioned. The following mixture has proved very satisfactory, and is recommended for general work.

50 per cent. Staveley No. 3.
50 per cent. Staveley Forge No. 4.

Where founders are desirous of using scrap, a percentage of the Forge No. 4 may be omitted, and the balance made up with good clean machinery scrap.

Grade Foundry 4 Iron.—Closer grain than No. 3 Grade, the graphitic flakes being less pronounced, and only partly distributed on the section of the pig. This iron may be used for general work, but requires less addition of the closer grades, or of scrap.

Grade Grey Forge Iron.—A medium close grained iron, suitable for castings required to be clean, and easy to machine. It may be mixed along with the more open grades, and can be relied on to give a good clean casting. The amount used can be varied according to the particular grade of iron and casting required.

Grade Forge 4 Iron.—A close grained iron, suitable for mixing with the more open grades in a similar manner to Grey Forge. The resultant casting when using this iron is of a stronger nature and allows for easy machining. Very suitable for cylinders, and heavy machinery castings, and is also much used for forge work, for which use this grade is eminently suitable.

Grade Close Forge Iron.—A very close grained iron, suitable for mixing with the more open grades.

Grade Mottled Iron.—A very close grained hard iron, the graphitic carbon and combined carbon contents being approximately evenly distributed, the graphitic carbon being in a very fine state of division throughout the pig.

It may be used with the higher grades of iron, and when so mixed is suitable for castings required to be strong and close grained, and also tends to increase the transverse strength.

The amount used can be varied to suit the particular class of casting required and grade of iron.

In mixtures containing a percentage of this grade of iron, care should be taken to ensure thorough mixing in the cupola.

Grade White Iron.—This iron may be used when mixed with varying percentages of the more open grades of iron for the production of castings required to be hard and of a close grained nature.

In mixtures containing a percentage of this grade of iron, care should be taken to ensure thorough mixing in the cupola.

Grade Silky Foundry Iron.—A soft siliceous iron suitable for mixing with close grades of iron or scrap.

Two other chapters that should be of assistance to all interested in foundry work, and the production of castings, are "Constituents of Cast Iron," and "Cupola Practice," the information contained therein being of help to those people who are responsible for the melting and mixing of cast iron, whether in large or small quantities, and as the second paragraph says, "enable them to avoid the many pitfalls which are associated with the mixing and melting of cast iron thereby

eliminating, as far as possible, the 'wasters' due to unsuitable metal."

The former chapter as its title implies deals with the various elements in connection with iron, and describes in some detail their varied characteristics, while the second chapter explains the different actions and results of the several elements when subject to the heat of the cupola, and when in a molten condition.

One of the most important departments is that of the foundries, and though mentioned last is certainly not the least, as the Staveley Company is one of the best known manufacturers of cast iron pipes throughout the world, and there can hardly be a country but what has had a share of "Staveley" pipes.

The output is about 1,000,000 pipes per annum, and in addition a large quantity of special fittings such as bends, tees, branch pipes, etc. The uses for cast iron pipes are many and varied, a few being water, gas, steam, hydraulic power, sewage, etc. The sizes are arranged to meet all requirements from 1½ inches diameter up to large pipes 6 feet diameter.

The foundries also manufacture large quantities of cast iron tunnel segments, pit tubbing, columns and general castings.

A WORLD'S RECORD IN TRANSPORT ECONOMY.

REMARKABLE as are the results obtained with the Scammell Articulated Six-wheeler for loads of 12 tons which was until recently the standard production of Scammell Lorries, Limited, the firm's new Eight-wheeler has established fresh records and become so popular in a few months that it now forms the bulk of their output. The new machine follows the same general outlines as the Scammell Six-wheeler as regards the motive unit, though with several detail improvements.

The "carrier" or load-carrying portion of the machine has an entirely new patented system of suspension at its rear end. In place of the single long axle there are two short axles in line; each of these axles carries two road wheels, and is attached to the frame through a single very wide leaf spring, the ends of which are provided with longitudinal pivots in addition to the ordinary spring eye and slipper. Each short axle with its wheels can oscillate about the longitudinal axis so that all four wheels conform to the contour of the road. Furthermore, the shock caused by any one wheel entering a pot-hole is reduced to one-quarter by the balancing action of the short axle, so that the rolling resistance on bad roads is greatly reduced. Since the wheels follow the camber of the road perfectly, the tyre contact even on a good road is much better than with the orthodox arrangement.

When designing this new vehicle the makers expected to get an improved general performance. Actual results, however, have exceeded even their expectations. The new vehicle, on account of the much lower rolling resistance and other improvements to be mentioned later, is taking loads of from 15 to 18 tons at a higher speed than the Scammell Six-wheeler carrying a load of 12 tons, and at a petrol consumption which is actually less. Long-distance road tests have given consistent figures of 132 ton miles per gallon. This is, we believe, a record in the history of the internal combustion engined commercial vehicle.

Contributing to this result are new features incorporated in the motive unit. The engine has a somewhat higher compression and an inlet manifold of the Claudel-Hobson atomiser type; a four-speed gear box is used in place of the three-speed box on the Six-wheeler; and all wheels, including the carrier wheels, run on Timken roller bearings fitted on detachable sleeves. These sleeves carry the bearing adjustment nuts, and are so arranged that any wheel complete with its roller bearings and sleeve can be drawn off the axle as a unit without touching the bearing adjustment. Adjustment of the bearings when required can be effected before the wheel is put on its axle.

The brakes of the new machine follow the Scammell patented construction whereby the carrier wheel brakes are applied by simple mechanism in which a steel pin passing through the axis of the turntable forms the brake connection between the motive unit and carrier. The whole of the mechanism runs on roller bearings, and the effort required to apply the brake is thereby much reduced, and the vehicle is braked on six wheels, and with a load of 18 tons is under better control than the standard six-wheeler with a load of 12 tons.

The new Eight-wheeler system has been applied to the firm's "Frameless" tank wagons, some of which are carrying loads up to 3,300 gallons. The same principle is also used in the firm's special 25-ton Machinery Carrier. Here the four 12-inch single solid tyres support the rear of the carrier, and take approximately two-thirds of the paying load. The carrier frame is integral with the steel body, and the floor is only 1 foot 8 inches from the ground. By a simple arrangement of hand-operated screws the end of the frame can be lowered to the ground and the two axles and wheels rolled away. A steel ramp which normally acts as a mudguard over the wheels is then lowered, forming an inclined plane down which the load can be rolled on to the ground. The whole operation of removing the rear wheels takes less than fifteen minutes. The machine has reduced the time of handling such items as heavy transformers and pieces of machinery to a fraction of that formerly necessary.

The Gazettes.

Punjab, April 20, 1928.

Buildings and Roads Branch.

On return from leave, Mr. A. K. Cargill, Executive Engineer, landed in Bombay on 6th April 1928, reported his arrival at the Public Works Department Secretariat on 9th April 1928 and took over charge of the duties of Deputy Secretary and Deputy Chief Engineer to Government, Punjab, Public Works Department, Buildings and Roads Branch, on the same date, relieving Mr. R. Trevor Jones, M. C., Executive Engineer and Under-Secretary to Government, Punjab, Public Works Department Buildings and Roads Branch, of the additional charge.

On being relieved of the charge of the No. II Simla Subdivision of the Simla Provincial Division on 28th March 1928, Mr. Champa Lal, Assistant Executive Engineer, joined the Simla Provincial Division on the same date and took over charge of the Division on 30th March 1928, from Mr. S. Bashiram, Executive Engineer, transferred.

Hydro-Electric Branch.

On transfer from the "E" (Engineering) Circle, which he left on 12th December 1927, Mr. W. G. Wheatley, Assistant Executive Engineer, joined the "T" (Tunnel) Division, on 17th December 1927, and remained attached to the Division up to the afternoon of the 19th December 1927. On 20th December 1927, Mr. Wheatley joined the "T/h" Subdivision at Brot, and took over charge of the Subdivision on 24th December 1927, from Lieutenant F. E. Pool, M. B. E., R. E., Assistant Executive Engineer, who, on relief, was attached to the Tunnel Division, Jogindar Nagar, with effect from the same date.

Irrigation Branch.

Lala Faqir Chand (1), Assistant Engineer, attached to the Muzaffargarh Canals Division, is allowed leave on average pay for one month and 11 days and in continuation leave on half-average pay for one year, six months and 13 days, from 4th April 1928, or subsequent date.

Mr. W. R. Allin, Executive Engineer, attached to the Public Works Department, Punjab, Irrigation Branch, is allowed by the High Commissioner for India, leave on half-average pay on medical certificate for six months, in extension of the leave granted to him previously.

Sardar Bahadur Bawa Sheo Singh, Bedi, officiating Executive Engineer, on transfer from the Dallas Division, 3rd Bahawalpur Circle, Sutlej Valley Project, which he left on 11th March 1928, took over charge of the Nowshera Division, 3rd Bahawalpur Circle, Sutlej Valley Project, on the same date.

Mr. A. Murphy, O. B. E., Superintending Engineer, Upper Chenab Canal Circle, is allowed leave on average pay for four months, from 1st June 1928, or subsequent date.

Khan Muhammad Aslam Khan, Temporary Engineer, on transfer from the Suleimanke Division, 2nd British Circle, Sutlej Valley Project, which he left on 10th March 1928, joined the Lower Dipalpur Division, 1st British Circle, Sutlej Valley Project, on the same date.

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INDIAN ENGINEERING.

SATURDAY, MAY 5, 1928.

TYPES OF BRIDGES.

IN the lecture by Sir E. Owen Williams, K. B. E. B. Sc., M. Inst. C. E., on Bridges, one of the series held by the Royal Institute of British Architects for workers in the building trades, there was a matter in connexion with the construction of bridges which, as far as we know, has not been put in the same way before. The lecturer said that it is usual, and only natural, to think of a bridge as being that part of the structure that man has built, the part that is seen. But to form fundamental conceptions of bridges, it is desirable in thinking of a bridge to include in the vision a section of the earth crust, regarding such piece of the earth as an intimate part of the bridge, because it is the resistance and assistance that the earth gives which determines the type of the bridge. It is not the visible structure, but the manner in which the earth is acting, that fixes the type. Bridges, Sir Owen Williams said, have become classified into three main types, the arch, the beam and the suspension. There are subsidiary various of these types, but they are the main types, and when each type is viewed with an appropriate section of the earth as a part of its system, they have all a common basis. That is to say, when any piece of the earth (whether it be fashioned into a bridge by man, or whether it be an overhanging piece of rock or a natural arch) has a void between it and the surface of the earth, two forces of nature are brought into play, compression which tends to crush material and tension which tends to tear material. Every structure, whatever its type, has these characteristics.

In the arch the portion built by man is in compression, in the suspension bridge it is in tension, in the beam it is both in compression and tension; but in the arch the necessary complementary tension is found in the lateral or horizontal forces which are put on to it by the earth, and in the suspension bridge the necessary compression is again found by the horizontal actions of the earth crust. The difference between the three types lies in the extent to which demands are made on the earth. The beam is self-contained and only requires vertical support, the arch and the suspension bridge require vertical and horizontal support, that is, they have in a sense to be "riveted" to the earth to prevent sideways movement. The extent of the so-called "riveting" fixes the nature of the bridge. A structure may look like an arch, but if it has not got the necessary riveting, then the earth will act on it as it does on a beam, and however arch-like the appearance it really is a beam. A curved appearance does not make an arch nor a suspension bridge, their types are determined by the nature of their attachment to the earth, and it was for that reason that Sir Owen Williams said that in picturing a bridge a section of the surface of the earth should be included also. It follows that in designing a

bridge, the type should to some extent reflect the nature of the soil below. Types are therefore not a matter of fanciful imagination but the result of the analysis of the conditions. In general, the nature of the soil is a factor which will eliminate or compel the adoption of certain types. The beam, or any variation of it, depends on vertical resistance of the earth alone, and can be designed so that considerable settlements have no effect on its security. The arch and the suspension bridge cannot permit of any settlement or movement of the ground. Movement of the ground will tend to make them into beam bridges, for which they were not designed, and danger or collapse would be the result. Sir Owen defined the true arch as one in which the forces are entirely compressive and the whole of the tension taken up by forces in the ground, and he added that this definition does not apply to arches flatter than one-sixth of the span. It is in this category of arches above one-sixth of the span that stone and other non-tensile materials find their place, and all the arches of the ancients are of this character. Arch-shaped structures with a rise exceeding one-twelfth of the span but not exceeding one-sixth will have, in spite of whatever attachment they have to the soil, serious tensile stresses and might be classed as semi-arches. Stone, brick and plain concrete are then no longer indicated, and tensile materials, such as reinforced concrete, steel and other metals have to be used. Structures which are flatter than one-twelfth of the span will be found to have very serious tensile stresses, and when exactly horizontal, tensile and compressive stresses are equal, the true beam is reached, making no demand on the soil except for vertical support. With increasing dip the suspension type is met, in which all the members are constantly in tension. The lecturer concluded with the words: "The problem of designing a bridge is therefore one of saturation of the designer with site conditions, to discover that one suitable bridge, and one only, which, meeting all and every one of the conditions of the site, is the only solution and the only bridge for that site. The soil conditions, waterways, flooding, traffic, must be explored to a conclusion, and then, having collected every condition, the bridge will almost design itself. The only danger will be for the designer and all those connected with the construction of the bridge putting themselves and their own fads into it, instead of following the simple and only rule of being just to materials whether under, in, or over the foundations."

These comments on the subject of bridges will not teach a man to design, they were not meant to, but they bring before engineers an aspect of the general question they may have imperfectly realised. Every great bridge-builder knows of course very well the principles on which a bridge is built, but that does not mean that because an admirable bridge has been built at some particular site, a similar bridge should be built at another site. The principles of bridge-building do not vary, but site conditions vary a great deal, and the great bridge-builder approaches every fresh task as if it were an entirely new problem with no examples of the past to help him. It is only in that way, as Sir Owen Williams explains, will the bridge almost design itself and will prove to be the bridge of all others that should be built. It is needless to say that these remarks do not apply to the numerous petty bridges of India, whether those on railways, irrigation channels or as the case may be, for which it is usual to have standard designs to save trouble or to guide the inexperienced. But then there are other bridges, bridges of some magnitude, and it is not often that any two of them will have to be designed to meet the same site conditions or the same functions. That is why, when we look around us at the works of great bridge-builders, we find them true to principles but otherwise of great variety. They are not reproductions of bridges built elsewhere, because in every case there are different circumstances and different conditions in which the battle with nature has to be conducted. It is well, moreover, for engineers that it should be so. There is no credit in being a copyist, but there is a glory when an engineer knows how to make a bridge almost to design itself. It is not the less a science because the engineer is acting in obedience to the facts he has to face, it is the greatest science; and engineers in India who have not thought of it quite in that light will glean a lesson from Sir Owen Williams' lecture. The full text of it is in the Journal of the Royal Institute of British Architects of the 10th March last.

AIR ROUTES OF INDIA.

On 9th March last, Lieutenant-Colonel I. A. E. Edwards, C. M. G., Chief Technical Adviser, Department of Civil Aviation, Air Ministry, read a paper on the above subject before the Indian Section of the Royal Society of Arts in London. From all that is said about aviation in the world, it may seem that in the march of events India lingers. Nevertheless, time being so important a factor in business and other transactions progress is bound to come, everyone recognises the benefits that will ensue from speeding up communications between all outlying portions of the Empire and its heart in England, and that rapid transit, if only from the business point of view, will save vast sums of money. As the lecturer said, when we talk of distances we are really thinking of time Only a few of us can state accurately the distance in miles from India to England or from India to any other place on the globe, but the time it takes to get from India to England or elsewhere we understand tolerably well. Time is the vital factor, and when air services link up the component parts of the Empire, distances, measured by time, become very appreciably smaller. Australia, relatively to England, will be brought to the position of Aden, India will be superimposed over Egypt, South Africa will be somewhere in the neighbourhood of Gibraltar, and Canada will be off the west coast of Ireland. Air transport will in fact squeeze, so to speak, the Empire together. India is, moreover, favourably suited for aviation, the climate

except in the monsoon period is ideal, and the business centres are at present widely separated.

Colonel Edwards gave the various air routes from England, working eastwards. There is a line from London to Berlin with an extension to Moscow, and also from London-Cologne to Prague and to Constantinople. An alternative route will probably switch off at Belgrade and run to Athens, thence *viâ* Rhodes and Cyprus to Haifa, and thence join with the Imperial Airways service now operating from Cairo to Basra. So with various other routes working in the same general direction. The route from Cairo to Basra *viâ* Baghdad is already established, and in the near future it should be in operation as far as Karachi. East of India, a main route will be from Calcutta to Rangoon, and it will eventually extend to Singapore and to Australia. There may be a second line from Calcutta direct to Mandalay, and thence across Cochin China to Hongkong. Once Hongkong is in connexion, it will only be a short time before a line serves Canton and joins up at Shanghai with the Japanese service. The routes from the west will enter India at Karachi and make Karachi very important, and the gateway to India from the east will be Calcutta and make Calcutta of the same importance in the development of air transport. The majority of the traffic will concentrate on Karachi on one side of India and on Calcutta on the other side. There will be routes both for heavier than air machines and for airships. The two will not be rivals, they will work in co-operation. The airship will fly by long stages, the first stop after England will probably be Egypt and the next stop Karachi. The aeroplane at these two points will act as a collecting and distributing service for the airship, not only from points off the airship route but also for places where the airship does not stop. The one will create traffic for the other.

Regarding the internal routes of India, there will be lines from Karachi *viâ* Delhi and Allahabad to Calcutta, and from Karachi to Bombay to connect with the Egyptian service. Next in importance will be the line from Bombay to Calcutta. An important service will doubtless run from Calcutta *viâ* Benares, Cawnpore, Allahabad, Lahore to Rawalpindi and Peshawar. A further route from Calcutta will follow the coast *viâ* Vizagapatam to Madras and on to Colombo, at which point it will probably tap an airship service. There may be two routes from Bombay to Calcutta, one *viâ* Nagpur and Jharsaguda and the other *viâ* Jubbulpore and Allahabad. The former is approximately 200 miles shorter, and the saving in time will make for simplification in the connexions for the extension to Rangoon. One of the Bombay-Calcutta routes and a section of the route from Karachi to Calcutta would be operated by night. The very important service from Calcutta to Rangoon is likely to be the first to be established, and flying day and night passengers and mails Rangoon should be reached from Bombay in twenty-four hours. The internal services will stimulate the internal trade just as the external services will stimulate the external trade of India. Under present conditions, if a man in Calcutta has business in Bombay which necessitates his spending a day or a part of a day there, he must be away from Calcutta for the greater part of four working days in order to spend less than half a day in Bombay. But with the establishment of a night air mail service, he will be away for one working day only. Similarly, as between Calcutta and Rangoon, two important business centres, the bi-weekly boat is scheduled to take fifty-two hours over the journey, but the flight could be accomplished in about ten hours. An air development, though not in the category of air transport, is that of air survey, and the great success of the survey by air of a large area in the Irrawaddy Delta has led to other surveys of the same nature elsewhere. In the lighter affairs of life, Colonel Edwards pictured the advantage during a hot-weather of being able to put in week-ends in the hills. He may have been a little optimistic, but the optimism of one day leads to the practical facts of another, and it may not be many years before we see aviation in India carried out on a scale that we may at present think impossible.

THE SILKWORM BEATEN.

THE opening of the British Artificial Silk Goods Exhibition at the Holland Park Hall in London on the 19th March has led the "Times Trade and Engineering Supplement" to issue a special Artificial Silk World Number. And it is a very interesting publication, for of all the surprising inventions of comparatively recent years, the taming of steam for the purpose of transport by railway trains and ocean steamers, the mechanically-propelled vehicles for use on roads, the conquest of the air by means of airships and aeroplanes, the telegraph, telephone and wireless as servants of mankind, there is really nothing more remarkable than the way in which artificial silk, equal to the natural product of the silkworm, is now being manufactured from forest timber. Nor is the process an ingenious freak of the chemical engineer, too costly to be of any commercial value. It has passed the stage of invention into that of widespread, everyday output at an extraordinarily low price. Silk, the beautiful gossamer spun by a worm, was once only within the reach of the few, but the imitation, the synthetic fibre, is now within the reach of the millions, and its beauty and utility, and the very large number of ways in which it can be used, render it a desirable commodity. It so happened by chance that its coming coincided with the strange changes in the fashions of women's dress. As the industry grew, women's clothes contracted in length, and as skirts became shorter, stockings became longer and much in evidence. The demand for cheap artificial stockings became enormous and gave a great stimulus to the business. But that does not matter now, because if the fashion changed and stockings were hidden the new yarn has many other uses. Every article of women's wear is now manufactured in the artificial material, "slippers are covered with it, shoes are laced with it, and it is the principal material

for stockings, garters, suspenders, corsets, *lingerie*, dresses, lace and embroidery. Even hats are made with *visca* or *monofil*, and decorated with ribbons or flowers made of artificial silk." It enters into the manufacture of bed coverlets, of heavy curtains and light casement blinds. It is used in combination with cotton and wool for various requirements. Its use in India for *saris* will doubtless extend, it should have a great vogue in Burma, and it is not only a question of women's attire. Men wear it in the shape of shirts, other haberdashery, and the silk linings of their coats will oftener than not be of artificial silk. There would also seem to be a future for it in the form of artificial hair. All manufacturing countries are producing increasing quantities of the material year by year, and in England the industry has an amazing prosperity. In 1926 the artificial silk yarn subjected to excise was 25,487,551 lb., and in 1927 the corresponding figure was 38,802,556 lb. India's total imports of artificial silk in 1926-27 amounted to Rs. 421 lakhs in value, against Rs. 218 lakhs in the preceding year. The Supplement tells a wonderful story of the progress and expansion of the British industry, and it is safe to say that the end is not yet. And while there must be unstinted admiration for the skill of the chemical engineers which has enabled forests to yield so immense a quantity of valuable fabric for the service of mankind, the skill of the mechanical engineers should not be forgotten. People who are not endowed by nature with the mechanical faculty may well regard the work of mechanical inventors in the light of magic, just as they wonder at the feats of magicians and conjurers, whose displays are often dependent on their mechanical ingenuity. The machinery in the factories where the various processes are carried out is of a very special and scientific kind. It has to be in order that a very delicate product can be weaved with success, and though remarkable results have already been achieved, technical improvements to overcome the many difficulties are steadily continued. It is only by the most perfect machinery that failure can be avoided, and the engineers, as well as the chemists, merit the admiration of the world for the production of a textile which is now of universal use.

DISASTROUS RIVER FLOODS.

In his work, "The Human Habitat," Mr. Ellsworth Huntington makes some comments on river floods in general and on the Mississippi disaster of 1927. It is of course well known that rivers in alluvial plains have a way of raising their beds and having raised them to break loose and flow in some other course. It is by that process that vast, flat alluvial plains have been formed. But if such rivers are confined within embankments there is ordinarily no scope for a change of course, nevertheless the beds continue to rise and the embankments have to be raised with them, until a heavy flood breaches the bank and causes calamitous conditions in the surrounding country. That was what happened when the Mississippi river of the United States broke loose last year, inundating an area of twenty thousand square miles and damaging property to an extent estimated at between two hundred million to a billion dollars. The breach drove nearly three-quarters of a million people from their homes and six hundred thousand of them were dependent on the Red Cross. The wealth and the power of the United States enabled much to be done for the sufferers, still they suffered, and what will be the final state of the inundated area is not known. Some land-owners have returned to their properties and others, it is believed, fear to return on account of the risk of further floods. Unless means can be devised to admit of the river changing its course and building up some other portion of its flood plain, there would appear to be no certainty of safety in the future. But, as the author says, bad as the Mississippi disaster was, if a flood of that intensity had occurred in China, it would have been considered a small affair. River floods in China are not only heavier but they occur more often. A flood affecting as many people as the Mississippi flood of 1927 occurs every two or three years, and once in a decade or so there are floods which afflict millions of people, possibly thirty, forty or fifty millions. In China the situation is rendered worse because the Summer rains are sometimes very heavy and they flood the depressions in the plains to a depth of several feet even if the rivers do not overflow their banks, and if on top of that rivers break loose the terrible conditions can be imagined. The Chinese, moreover, have no powerful Government behind them, they cannot draw on the sympathy, wealth and active help of a rich nation like America. It is only within a few years that they have even had a Famine Relief Commission and a Red Cross run by foreigners to afford relief. China suffers from famines due to floods and due to droughts. The droughts may last for years, and a drought may be followed by a flood, so that a hundred million people may suffer at one time. We have not a near view of China to enable us to realise all the horrors that the teeming population have endured. But there is sufficient in the thought to make India think. There were terrible famines in the old days, rivers abandoned their courses and there were droughts of great severity. Kings' ministers amassed wealth by selling grain at high prices when the people were being decimated by starvation, and those who are discontented with British rule would do well to remember that the great tragedies of the past have disappeared. Anyone who cares to refer to Mr. A. Loveday's work on the history and economics of Indian famines will see how the calamities of an older India exacted in full measure their tale of misery and human life; and the change from that time to a country, provided with railways, protective irrigation works and elaborate programmes for famine relief, under the rule of a beneficent Government, makes the case of the Chinese, dependent on the charity of other nations, piteous by comparison.

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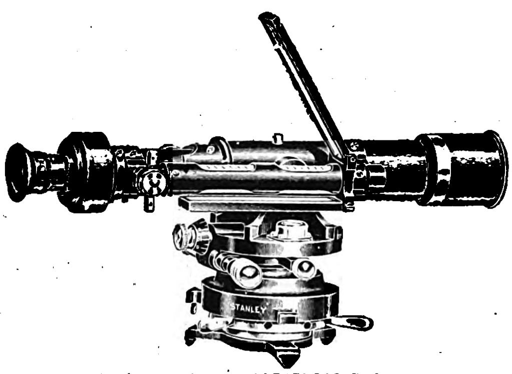
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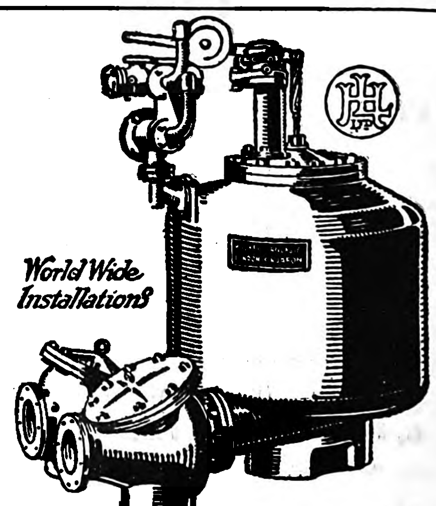


Notes and Comments.

"Cotton Manufacturer."—This is the title of a very handsome and well got up journal of which we have received the first number. The editor and publisher is Mr. P. V. Pathak, B. A., who states that it is the intimate journal of the cotton manufacturers. The journal is published with the sole aim to render service to the Indian Textile Industry. The first number is an excellent one and we wish it all the success it richly deserves. The address of the journal is Cotton Manufacturer Office, Reid Road, Ahmedabad.

Staff Changes, B.-N. R.—Mr. D. Leslie, Superintendent, Maintenance, and Acting Deputy Chief Engineer, having proceeded on leave preparatory to retirement from 15th April 1928, Mr. A. P. Macdermid, Superintendent, Works and Development, is, subject to the Home Board's confirmation, appointed as Superintendent, Works and Development, and Acting Deputy Chief Engineer from that date. Mr. B. Goddard has taken over temporary charge of the Loco. Shops as Works Manager, Loco., from 26th March 1928.

The Alton Battery Co., Ltd.—Sir Alexander Roger, Chairman of Automatic Telephone Manufacturing Co., Ltd., the International Automatic Telephone Co., Ltd., etc., and Director of British Insulated Cables, Ltd., etc., has accepted a seat on the Board of The Alton Battery Company, Ltd. Mr. W. R. Montgomery, A. M. I. E. E., Manager to the Alton Battery Company, Ltd., has also been elected to the Board, which now consists of the above two gentlemen and the founder and Chairman of the Company, Mr. C. C. Rattey, M. I. E. E.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 11th April 1928:—Messrs. F. and C. Osler, Ltd., Delhi—18 Fans, ceiling, D. C., Osler "Senior" type, 225 volts, fitted with aluminium blades, 54" sweep, with canopies and shackles, Rs. 1,935 free delivery at Bakshan Khan; Messrs. Martin and Co., Calcutta—140 cwts. Rounds, M. S., of sizes, Tata, Rs. 1,087 f. o. r. Calcutta; Messrs. Jessop and Co., Ltd., Calcutta—1 Motor, shunt wound, Rs. 1,040 f. o. r. Howrah; 180 r. ft. Chain, Acquatol, Rs. 1,193 f. o. r. Howrah.

Chittagong Port.—In accordance with the Chittagong Port Act, as recently amended by the Central Legislature, the following have been elected Commissioners, with Mr. J. Izat, Agent of the Assam-Bengal Railway, as Chairman:—Messrs. A. McKean, J. A. Oliver, F. C. Gray (Chamber of Commerce, Chittagong), Lal Mohan Choudhry, Abdul Rahman, J. N. Roy Choudhry (Indian Merchants' Association, Chittagong), Moulvi Abdul Haque Dovash (elected by Municipal Commissioners of Chittagong), Commander C. R. Bluett, Port Officer, Chittagong (appointed by the Government of India) and G. A. Wildy, Acting Chief Auditor, A.-B. Railway (appointed by the Railway).

Sukkur Barrage Damage.—Information received from the Chief Engineer, Lloyd Barrage and Canals Construction, shows that the reports of damage done by rain and floods to the cofferdam on the right bank at Sukkur have been greatly exaggerated. The cofferdam was breached on the night of 23rd April and immediate steps were taken to close the breach and get rid of the water that had flowed in. The Chief Engineer, Mr. C. S. C. Harrison, is himself at Sukkur and he reports that the damage to the masonry, etc., is absolutely *nil* and work is only likely to be delayed for a fortnight, while the damage to machinery due to submersion is only Rs. 5,000.

East Indian Railway.—The earnings of this Railway for the week ended 7th April recorded a decrease of Rs. 3,65,963 as compared with the figures for the corresponding week of last year. This decrease is due to the decline in the coaching earnings amounting to Rs. 3,77,921, partly on account of the Kumbh Mela at Hardwar last year and partly to the adjustment in last year's figures. The Ram Naumi Mela took place on 29th and 30th March, but the attendance was poor due to an outbreak of cholera and plague at Fyzabad and Ajodhya. The work on the loco. shop extension at Lucknow is progressing rapidly. Half the machinery has already been moved into the shop, which will be occupied by the end of May.

Gangakhali-Suadighi Drainage.—The first meeting of the committee on this scheme was held at Tamluk on 25th April, Mr. S. W. Goode, C. I. E., Collector of Midnapore, presiding. Nearly 1,000 people assembled from the villages to submit their objections to this scheme, which were mainly due to the fact that the khals would not be kept open, but would be closed by sluice gates at their mouths in the river Rupnarayan. The scheme would cost nearly Rs. 4 lakhs, of which nearly half would be required for the sluices to which the people objected, as they would not allow the inlet of water for irrigation. The late Chief Engineer and other experts were for keeping the mouths open. Of the ten members, including the Collector, six voted for the scheme without sluices.

King George's Dock.—The Calcutta Corporation have under consideration a proposal from the Port Commissioners for the transfer of a strip of Corporation surplus land for the purpose of improving the approaches to King George's Dock. In his letter, the Chairman, Port Commissioners, states in order to improve the approaches to King George's Dock the Commissioners are anxious to obtain permanent possession from the Corporation of a plot of land in order to provide a better alignment for the new level crossing gates. This would make it possible to have wider gates and broader level crossing and thus obviate or minimise congestion. The Chief Engineer to the Corporation reports that the proposal is a great improvement and may be agreed to. A lease, however, on a nominal rent would be more suitable than to give up the land wholly. The Chief Executive Officer suggests that a lease on a nominal rent should be granted.

A New Type Limousine.—A new type of closed car has recently been introduced by The Sunbeam Motor Car Co., Ltd. This is a limousine model built on the Weymann principle, and is supplied on the 16 h.-p. Sunbeam chassis. The division between the front and rear seats has sliding glass panels in the upper portion so that the rear compartment can be entirely separated from the driving seat when desired. The driving seat is adjustable for position and all door lights are raised and lowered by mechanical regulators. The interior accommodation and appointments are very similar to those of the 16 h.-p. Saloon model, which is one of the most popular cars the Sunbeam

Company has ever introduced. Ample leg room for the rear seat passengers has been very cleverly obtained on this new limousine. The bottom portion of the division is recessed to take a footrest and by this means several inches of extra space is available and a particularly comfortable position is obtained. In every respect this new model embodies the high standard of design and finish for which Sunbeam cars are noted.

Bengal-Nagpur Railway.—Four provinces—the Central Provinces, Bihar and Orissa, Madras, and Bengal—will benefit by the programme of development mapped out by this railway. Eleven new lines, with a length of 838 miles, will be added to the system. The construction of four lines will be undertaken this year. Madras and the Central Provinces will be linked by the Raipur-Vizianagram Railway, 241 miles. This is a most important project, and the line will cost the railway approximately Rs. 419 lakhs and it is expected it will be finished by the year 1931-32. The following are the new lines included in the quinquennium programme besides the four lines undertaken this year:—Berhampore-Russelkonda, 49 miles, Rs. 49 lakhs. Guttilanagar Branch Railway, 8 miles, Rs. 8 lakhs. Kantabanji-Bolongir, 47 miles, Rs. 47 lakhs. Dumermura-Nowraigpur-Jeypore-Ramgiri, 147 miles, Rs. 147 lakhs. Nowrangpur-Jagdalpur-Dantiwara, 83 miles, Rs. 83 lakhs. Dhamtari-Kanker, 43 miles, Rs. 21 lakhs. Muri-Ranchi Conversion, 35 miles, Rs. 23 lakhs. Chandrakona Road-Ghatal, 27 miles, cost has not been ascertained. In all about 300 miles will be surveyed during the coming year.

Singapore Automatic Telephone.—This is a system of the latest design, and will be opened in Singapore on 1st January 1930, when the present local working will give way to an automatic exchange. This decision of the Oriental Telephone and Electric Company marks another step in the modernisation of Singapore. The existing central exchange has a capacity of 5,000 lines, which will be in full use by the end of 1929, and then the new system will provide accommodation for 6,600 lines, with an ultimate capacity of 10,000. At first the Company intended to keep the manual exchange until it had served its full economic life, and to build an automatic exchange for increasing requirements. It was realised, however, that the operating staff would have to be supplemented considerably for the transition stage between manual and full automatic, with manual automatic plant worked conjointly. Further, the Company has experienced great difficulty in meeting its present needs, despite an increased scale of pay, and as a result of all these circumstances it was decided to embark upon the full automatic scheme without delay. The system to be adopted is that used by the British Post Office and known as the "step by step" system. The equipment will be of British manufacture.

Winning the "Maudes" Trophy.—Undoubtedly the most coveted award in the motor-cycle industry for the year is the "Maudes" Trophy, which is placed at the disposal of the A. C. U. for what they consider the most meritorious performance during the previous 12 months. In the trade there is usually very keen competition, and last year it was considered that three firms were in the running for it, says "Magnet" in "The Sunday News." The Norton machine, having put up such fine records on Brooklands, was thought to have a very good chance. The Rudge-Whitworth, on account of its successes in many arduous trials throughout the year, was also considered a likely winner, but the Ariel was eventually given the award on account of the wonderful 5,000 miles non-stop engine run which it went through in the latter part of 1927. The test is the more remarkable from the fact that never before has an air-cooled engine been run without a stop for any purpose whatever for a period of approximately 10½ days. Even after that long period this engine had to be intentionally stopped, and at the end of the test it was running as well as during any period of the ride. The trial was carried out under A. C. U. observation with an A. C. U. observer in the side-car, and the whole distance covered was 5,011 miles. On completion the engine was dismantled and was found to be in first-class condition. Such a performance is not only unique, but proves the wonderful reliability and stamina of the Ariel productions. The firm are to be congratulated, and no doubt they will feel the effects of this in increased demands for their productions during the forthcoming season.

Welding Aboard Ship.—From time to time we read accounts of cases where ships have been put into positions of great danger, due to the breakage of an essential engine part or of a steam pipe. Occasionally the damage is made good temporarily, and the ship limps to the nearest port to undergo repair, which, in some cases, involves the outlay of very large sums of money, in addition to the loss incurred due to delay. The possession of arc welding plant and equipment aboard ship, together with a trained operator in cases of emergency would render vessels to a great extent independent of shore repair shops. Arc-welding to-day is in a very different position to what it was even five or six years ago. Improved methods and materials are being introduced day by day by such firms as Alloy Welding Processes, Ltd., and it is only very rarely that any metal part cannot be repaired so that it is in as good a condition as it was before the breakage occurred. In many cases a part which was originally on the weak side can be reinforced during the welding operation. It might be argued that only comparatively small parts could be welded. This is not so. There is no reason why a fractured crankshaft or a main shaft should not be satisfactorily welded, or put into a condition which will enable the ship to carry on at a reduced speed. Such jobs, however, as a fractured casing or a fractured steam pipe could be very speedily put into good repair. Fractured tubes or fractured boiler plates could be very easily made good. A multitude of other parts which cause a deal of trouble under ordinary circumstances could very quickly be made fit for service. The advantages to be gained by installing welding plant are so great, that it will certainly not be long before every ship is so equipped.

"Ubique."—A firm of British manufacturers which has won a very enviable reputation for its products both at home and overseas is that of Jowett Cars, Ltd., whose works are at Idle, Bradford. Since its inception in 1901 the policy of the firm has been to produce the most reliable and economical car possible, and that these ideals have been achieved is amply proved by the testimony of satisfied owners all the world over. The Jowett engine is 7 h.-p., two-cylinder horizontally opposed, and is remarkably well balanced and smooth

running. Further, by reason of its layout considerably more body space is available than in light cars fitted with ordinary four-cylinder engines. As for petrol consumption, although the "Full Four" is advertised as doing 40 m. p. g., numerous owners are obtaining 50 m. p. g. and even more. In this connection an owner in Batavia, Dutch East Indies, claims a consumption of 50 m. p. g. regularly, and this under very strenuous conditions. For instance, he averaged 25 m. p. h. quite easily on a trip of 120 miles in the course of which he climbed to 3,000 feet, dropped again to 1,500 feet, climbed again to 3,500 feet, dropped once more to 2,000 feet, and eventually ended at 2,500 feet above the sea level. Another user, this time in Cairo, praises the Jowett's performance in extreme heat. As an example he took his own car some miles over the desert, much of it in low gear, with the temperature at 117 degrees in the shade, with no sign of overheating. It is interesting to learn that the car which this particular enthusiast tried originally, and which may be said to have made a convert of him, had, at the time of the trial run, already done 30,000 miles and had not been overhauled for two years. Yet, the trial run took place with a shade temperature of about 100 degrees, and it was driven through loose sand and up sand dunes without boiling or distress. Small wonder that on conclusion an order was booked at once. Owners of these sturdy little cars, writing from places as far apart as New Zealand, Spain and South Africa, all tell the same story of absolute satisfaction and admiration of their economical qualities.

Commercial Applications of Surface Combustion.—The vast numbers of visitors to the Birmingham Section of the British Industries Fair, which dealt with the heavy section of British industries, were visibly impressed with the quality of the exhibits and the rapid strides which the Fair has made in the last few years. Last year, for instance, the Birmingham Section covered an area of six acres; this year it covered 10½ acres, while the number of exhibitors increased from 600 to 900. Very considerable interest was shown in the exhibit of The Metropolitan Fuel Co., Ltd., of Westminster, which controls the Cox system of surface combustion. Surface combustion is, of course, widely recognised as the most efficient and economic method of utilising the heat value of any combustible gas and, moreover, the principle can be adopted for every purpose, whether industrial or domestic, where heat is required. The basic feature consists in mixing any combustible gas with air, passing the mixture thus obtained through a porous refractory medium and lighting it on the surface of the opposite side where it burns without flame. No oxygen is taken from the surrounding atmosphere and the surface only of the refractory medium becomes highly incandescent. Complete combustion is secured and radiant heat given off. The most important factor in true surface combustion is the porous refractory medium. The Cox Ignite Combustor can be made to any size and shape, whether regular or irregular, and so provides a means of "closer" effect than can be obtained in any other way. At Birmingham, two 12-inch diameter Combustor burners were shown in operation. The various sizes and shapes of Combustor bricks were on view, including rectangular, circular and tubular. Of particular interest to the textile industry was a large combustor of the pattern used for singeing cloths. Increased rapidity of operation is obtained by this method. Various sizes of soldering iron heaters were on view, as well as a metal melting pot. The advantages of the Cox Ignite Combustor in both cases include instant and graduated regulation, whereby the mixture of gas and air is so regulated as to give the maximum efficiency of heat with the minimum consumption of gas; entire absence of carbon monoxide; a flameless atmosphere. The aggregate economies in gas consumption amount to over 30 per cent. Other applications of the system on view included an enamelling oven, employing combustors and thermostatic control, and a glass demonstration water tank, fitted with silica tube and two combustor burners, showing the suitability of the Cox system for water heaters and solution tanks.

General Purpose Winches for Lifting and Hauling.—Lifting and hauling by hand labour is out of date. Labour may be cheap, but it is undoubtedly slow and much time and money can be saved by the installation of easily manipulated winches or hoists, wherever necessary. A portable and compact type of winch is manufactured by Messrs. John Fowler and Co. (Leeds), Ltd., built in two types to lift 10 or 15 cwt. (500 or 750 kg), fitted with Petter Petrol Paraffin Engines of 3 h.-p. and 5 h.-p. respectively. Messrs. Fowlers have built many large winding engines and mine hauling gears in the past, but the machines now referred to, while maintaining the reputation of the firm for sturdy construction and trustworthiness, fill the needs of a very different class of work, as they can be turned to almost any use for which hauling or lifting power is required. They can be applied for haulage work in quarries or gravel pits, or on all kinds of contracting work. For works and factories, for hauling railway wagons into position, and for loading and unloading them as well. In many cases, such as in warehouses and stores or for loading lorries and drays where hand labour has been the accepted method for so long that power loading has never been thought of, they can be used with advantage and with great saving of time and cost. For interior use or in other cases where required, the winches can be fitted with electric motors, instead of paraffin engines, and so eliminate all noise and smell. In building work these winches are widely used either by themselves or in conjunction with the Fowler special elevator and platform cage. These elevators are built in sections and fitted with large cleats for attaching to the scaffolding or to the building itself. Extra sections can be added as the building goes up and the hoist and elevator used for lifting bricks, mortar, concrete, roofing materials, timber and all the other requirements of a building in course of construction. The winches are entirely operated by one lever, so that the brake and engine drive cannot possibly be both put into action together, and they are designed throughout to be worked by inexperienced, unskilled labour without causing trouble. They are mounted on steel frame beds, suitable for bolting down, or, if required, they can be fitted with wheels for portable use. Many of these winches are already in use overseas as well as in Great Britain, and they are being adopted by many Government departments and large contractors for all kinds of work. The compact and sturdy construction appeals at once to the engineer, while the low cost of running and upkeep are recognised by all users as soon as they have got them at work.

Current News.

THE Road Development Committee will meet in Poona in July for discussion of the draft report.

MR. W. H. THOMPSON has resigned his seat on the Calcutta Corporation as he is going home on leave.

SOME shallow carboniferous strata have been discovered in the basin of the Viar, Seville Province of Spain.

IT is understood that Mr. E. H. Berthoud has been appointed Chairman of the Coal Enquiry Committee *vice* Mr. H. I. S. Forest.

THE death has occurred of M. Jaques Schneider, donor of the famous Schneider Trophy at present held by Great Britain.

THE P. and O. Steam Navigation Company have declared a dividend of 5 per cent. tax-free on deferred shares for the half-year.

MR. P. R. RAU, Director of Finance, Railway Board, has left for South India on a short visit and will be returning to Simla next week.

MR. PAIZULLABHAI GANGJEE has been elected President of the Indian Chamber of Commerce, Calcutta, in place of Mr. D. P. Khaitan, resigned.

TWO French engineers, Louis Hirschauer and Augustin Talon, have invented an aerial torpedo for transporting letters and packages at a speed of nearly 300 miles an hour.

WHAT is claimed to be the longest European telephonic communication, was successfully tested between Kiruna in upper Lapland and Geneva, a distance of 2,422 miles.

THE Government of Madras are shortly issuing orders for widening the upper supply channel from Cholavaram to the Red Hills Tank, to ensure a sufficient supply of water in Madras City.

IT is proposed to construct an aqueduct capable of conveying from 20 million to 30 million gallons of water a day up the Yarra Valley, beyond Warburton, for augmenting the supply of water to Melbourne.

THE total production of coal on the Newcastle and Maitland fields, New South Wales, has shown a steady annual decrease during the past four years, from 8,077,689 tons in 1924 to 6,800,000 tons in 1927.

MR. S. C. STUART-WILLIAMS, Chairman of the Port Commissioners, Calcutta, has been granted leave for 5 months and 15 days from 4th May. Mr. T. H. Elderton, Deputy Chairman, will officiate as Chairman.

IN the House of Commons, in reply to questions, Mr. A. M. Samuel (Con. Surrey, Farnham Div.) said that the interest which had accrued to the Government from its holding of Anglo-Persian oil stock totalled £6,043,000.

ON Class I railways during the week ended 7th April 1928, 86,359 wagons were loaded on the broad gauge (4,819 more than in the corresponding week of 1927), and 59,719 on the metre gauge (7,648 more than in 1927).

THE four South African Air Force aeroplanes, which accompanied as far as Khartoum the return journey from the Cape to Cairo of the Air Force annual exercise flight, have started on an attempt to reach Pretoria in four days.

THE constitution has been sanctioned of a division in the Waterlogging Investigations Circle, Public Works Department, Punjab, Irrigation Branch, to be named the Chenab Drainage Division with headquarters at Sheikhupura.

THE Viceroy's silver medal for the best essay on "Agriculture" has been presented by Sir Norman Bolton, Chief Commissioner, North-West Frontier Provinces, to Lala Wazir Chand Mehra of the Edward's Mission College, Peshawar.

SEISMIC shocks are still being experienced at Corinth, but most of the population have declared that they will not abandon the historic town which will be reconstructed on the same site, houses to be built, as far as possible, earthquakeproof.

THE Anglo-Persian Oil Company have struck a new oil well at Naft Khaneh near Khaniqun in contiguous Persian territory, which is capable of producing 450,000 gallons a day. This is the second well in this area, the other being on the Iraq side of the border.

THE Government of Madras have appointed a committee to go into the question of the Mettur Dam. The personnel of the Committee will be announced shortly. The estimates for the dam have been revised, and will be shortly circulated to the members of the Legislative Council.

THE Gold Medal of the Institution of Mining and Metallurgy has been awarded to the Right Hon. Sir Alfred Mond, "in recognition of his scientific and industrial services in the development of the mineral resources and metallurgical industries of the British Empire." The medal will be presented to Sir Alfred Mond at the annual general meeting of the Institution to be held at Burlington House on 17th May.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

A VALUABLE FEATURE.

SIR,—Everybody who has had any experience of overhead valve motor-cycle engines knows that one of the weak spots is usually the valve guides. For certain reasons in the design of an overhead valve engine the valve guides are necessarily a little shorter than the valve guides used on a side-valve engine of similar cylinder capacity. In addition, the load comes on the valve stems in an overhead valve engine direct from the rockers, which are, of course, moving in a circular path, and thus there is a certain amount of side pressure caused between the valve stem and the valve guide. On a side-valve engine, this side pressure is not present, because the valve stem is operated by the valve tappet, which moves in a straight line. For these two reasons it is common to find that the life of the valve guides of an overhead valve engine is comparatively short, and consequently the valve gear soon becomes noisy and air leaks occur down the inlet valve guide, which are apt to upset carburation or spoil slow running.

This trouble, however, is not met with on "Matchless" overhead valve engines, since the "Matchless" valve guides are of very special design. In addition to being made as long as is possible, so as to give the greatest wearing surface obtainable, the valve guides are made from specially heat-treated cast-iron, which has a very high resistance to wear, while automatic lubrication is provided by the provisions of grooves on the wearing surface, which grooves are filled by a special process with solid graphite. This graphite, of course, provides a lubricant for the valve stem during the whole life of the engine. As a result of these special features, it can be said that the valve guides on "Matchless" overhead valve engines wear at least as well and probably better than the valve guides on any side valve engine. These remarks apply on the 1928 range of "Matchless" machines to the Models T/S, L/R2, V/2 and "M."

LONDON, *10th April 1928*. MOTORIST.

Literary Notices.

Reinforced Brickwork Pitching.—Mr. A. K. Datta, B. E., C. E., A. M. I. C. E., Consulting Engineer, has published another book entitled "Developments in Reinforced Brickwork Pitching." The contents are:—Reinforced brickwork pitching. 3-inch Reinforced brickwork pitching. Anchored reinforced brickwork pitching. Harnessed dry brick or boulder pitching. Heavy R. B. pitching, Ribbed R. B. pitching. Box R. B. pitching and Reinforced concrete pitching and lining. The book is supplemented with a number of drawings illustrating the subjects treated of and the information supplied is full and conclusive.

Kempe's Engineer's Year-Book for 1928.—Compiled and edited by H. R. Kempe, M. Inst. C. E., M. I. Mech. E., M. I. E. E., and W. Hanneford Smith, F. R. S. E., Assoc. Inst. C. E., M. Inst. Met., with the collaboration of a corps of specialists. Revised throughout and brought down to the latest date, with a review of engineering progress during the past year. Thirty-fifth edition. Containing over 3,000 pages, with 2,500 illustrations, specially engraved for the work. Crown 8vo., limp leather binding, gilt. Crosby Lockwood and Son, 7, Stationers' Hall Court, Ludgate Hill, London, E. C. 4. Price, 30s. net.

This wonderful publication, the value of which cannot be over-estimated, and which has involved a colossal amount of labour, is one which has no equal and no rival at the present day. It is a compendium in one volume of the modern practice of civil, mechanical, electrical, marine, gas, aero, mine and metallurgical engineering. The volume is a complete library in itself and is indispensable for reference to all engineers the world over. The information conveyed is so vast, that it is impossible in a brief notice to give even a faint idea of the contents of this magnificient production. It contains everything which an engineer needs in his daily practical work. The volume is an outstanding one in every respect.

INDIAN ENGINEERING.

Addresses and Changes of Addresses.

In requesting change of address give **old** as well as new address and write legibly.

The full and correct address should always be given on **Money-Order Coupons**—see instructions thereon.

A.J.W.

Foreign Notes.

Mersey Reclamation Scheme.—A scheme for the reclamation of a portion of the river Mersey and the construction of a promenade at Otterspool, at the south end of Liverpool, the estimated total cost being £100,000, has been approved by Liverpool City Council. The spoil removed from under the bed of the Mersey in the construction of the Mersey Tunnel will, it was stated, be utilised in the work of reclaiming about fifty acres on the river front. The proposed promenade will be a mile and a half in length.

Canadian Government Research Laboratories.—The Canadian Minister for Trade and Commerce announced in the House of Commons at Ottawa recently that the Dominion Government intends to erect in Ottawa the first unit of a National Research Laboratory, together with a central power plant. The amount of $750,000 appearing in the estimates was considered to be sufficient for the first year's programme. About $3,000,000 would be required during a period of from five to ten years to construct at Ottawa the laboratories necessary to carry on the work. The Advisory Council for Scientific and Industrial Research also asked for an increase from $170,000 to $300,000 in the funds provided for administrative purposes, and this increase was to be found in the estimates.

Reinforced Concrete Bridge, Montrose, Scotland.—Under a provisional order, Montrose Town Council, Forfarshire, has received powers to expend a sum not exceeding £90,000 on the partial demolition and reconstruction, in reinforced concrete, of the Montrose bridge over the South Esk. The designer of the bridge is Sir E. Owen Williams, K. B. E., of Westminster. Prior to the demolition of the existing bridge, which is of the suspension type, a temporary bridge will be erected alongside, at an estimated cost of £12,000. It is expected that the new bridge will cost about £70,000 to build. Contingencies have been allowed for to the extent of £8,000. It is anticipated that operations will be commenced shortly, and that the bridge will be completed and put into service by 31st March 1930.

Barrage Construction.—The protest of M. Gustave Mercier, President of the Comité Français des Grands Barrages, against the assertion of M. Mesnager that the solid barrages at present constructed do not offer a sufficient margin of safety, has elicited from M. Mesnager a further reply to the effect that the margin of safety of solid barrages of triangular section is so small as to offer a positive danger, particularly on account of the insufficient length of spillways which are subjected to abnormal pressures in times of flood. M. Mesnager states that the barrages at oued Fodda and oued Mina in Algeria are likely to meet the same disaster as that at Perrégaux ; that the barrage at oued Beth in Morocco is liable to suffer the same fate and that another dam which does not sufficiently provide for a release of pressure in times of flood, and may therefore collapse, is the barrage de la Curie in France.

Comparison of American and British Explosives.—A recent comparison made by the U. S. Bureau of Mines of typical explosives used in American and British coal mines shows that, as judged by the gallery test, the average British "Permitted" explosives is safer, but has a lower explosive strength and is less sensitive to detonation than the average American "permissible." In other words, detonation of a given weight of British explosives is less likely to ignite gas or dust in a coal mine than the same weight of American "permissible," provided the British explosive detonates completely. On the other hand, the Bureau asserts the low sensitivity of the British explosives indicates that accidents due to misfires, incomplete detonation, and burning in the bore-hole will be more frequent. They believe, therefore, that the American "permissible" explosives represent the best compromise at present obtainable between "gallery test safety" and efficiency and sensitivity.

Aeronautic Engineering.—The University of Toronto has established a new course in aeronautical engineering in the Department of Mechanical Engineering. It will be an optional course embraced in the third and fourth year of the Department. The new fourth year option will be directed especially towards aerodynamics. The new course provides only for those students who may be proceeding to the degree of applied science, and owing to the limited space in the aerodynamic laboratories the number of students permitted to take it will necessarily be limited. The laboratory contains the only wind tunnel in Canada. It was established there during the latter part of the war and has been the means of carrying out important research work. The new course will be under the general supervision of Professor R. W. Angus, head of the Department of Mechanical Engineering, and the lectures and the laboratory work will be more particularly carried out by Professor J. H. Parkin, of the Department.

Geodetic Levelling Staff.— In geodetic surveying, where differences in elevation must be determined with the utmost practicable accuracy, the ordinary levelling apparatus is replaced by a more accurate and sensitive instrument and a staff of special design. Before 1916 the U. S. Coast and Geodetic Survey used a wooden staff with graduations painted on its face. The wood was boiled in paraffin. This increased the weight and lowered its resiliency. In addition it was found that, while in the spring and autumn, before and after the season in the field, the length of such a staff showed itself to agree with a standard, there was, however, a departure from correctness during the season. Thus errors found their way into the results. The improved staff consists of a metal strip rigidly attached to a footpiece of steel and supported by a wooden back. The metal strip, about 3.3 m. (say 11 feet) long, is of invar with a temperature coefficient of not more than 0·000002 per degree C. A temperature change of 50 degree Fah., which might readily occur during a working day, will cause a difference of only about 8-1,000 of an inch in the total length, an amount which under ordinary conditions would be negligible. For the most precise work, however, this is corrected for by computation, thermometer readings of the temperature of the strip being taken while the staff is in use.

Night Signs for Motorists.—A demonstration was given recently in Richmond Park by the Automobile Association, Fanum House, New Coventry Street, London, W. 1, of some of their new road signs and devices which should generally improve motoring conditions after dark. Illuminated direction posts, which in themselves should constitute a most efficient danger signal, were shown, having floodlights fixed immediately over the arms, the necessary power for which being obtained from the mains when available ; otherwise batteries are provided. A further solution to the problem, which seems to be the most practicable for country roads, is making the posts only 2 feet or 3 feet high, so that the arms come well into the beams of approaching headlights. Danger signs, giving warning of dangerous crossings or sharp bends and obstructions, were demonstrated, the latter consisting of red and white reflectors mounted on short posts, the red ones to be passed on the right and the white on the left. A demonstration was also given of the Automobile Association's fog flares, which were first used last autumn, much to the benefit of all users of the road.

Water Supply of Shanghai.—Water supply from the new plant of the Chapei Electricity and Waterworks Company, Ltd., at Dike Road, Military Road, Chapei, Shanghai, was begun on 15th February 1928. Construction of the new plant started in August 1926, and the cost has been about £200,000. The plant is capable of supplying water at the rate of 12 million gallons every twenty-four hours. The water is drawn from the Whangpoo River instead of the Soochow Creek, which was formerly the source of supply. The new plant possesses the following features :—(1) Two coagulation basins, twelve rapid sand filters, and two chlorinators, the combined capacity of which is 12 million gallons ; (2) one pump house equipped with a centrifugal pump driven by motor with 1,000-kilowatt power and with a water pressure equivalent to 100 lb. to the square inch at the works and 40 lb. per square inch for hydrants ; (3) five purified water reservoirs with a capacity of 957,000 gallons ; (4) a water tower 95·5 feet high with a capacity of 170,000 gallons ; and (5) water mains consisting of cast-iron pipes, 36 inches in diameter, which are connected with the old distribution system and aggregate a total length of 7·5 miles.

Structural Steel and Concrete Bars.—According to a report by the American Iron and Steel Institute, the output of concrete reinforcing bars in the United States in 1926 was 815,829 tons. Of this total it is estimated that 571,000 tons was used in the structural part of buildings. When thus used it has been estimated that 1 ton of concrete bars displaces about 5 tons of structural steel. Consequently, the structural equivalent of the concrete bar tonnage which went into buildings would be 2,855,000 tons. Deducting from this the tonnage of concrete bars used in the buildings, the possible steel market lost in one year to concrete is 2,284,000 tons. Another method of approaching the problem is based on an estimate that 60 per cent. of all the structural steel made goes into large buildings. Production of structural steel in 1926 was 3,911,663 tons, of which 60 per cent. is 2,347,000 tons. It is reported that about half of the large buildings in the United States are erected with structural steel frames. As the other half are built of concrete, the possible structural steel market lost in one year would thus be about as great as the amount which is used. This figure is within 3 per cent. of that determined by the other method. It does not, however, take account of the concrete bars.

Transparent Metal Sheets.—Sheets of metal so thin that ordinary type can be read through them are now available as the result of research by Dr. Carl Mueller, of the Charlottenburg Laboratory, Berlin. According to "Nature" his method of preparing them is to electro-plate the metal on the surface of some soluble substance, such as rock salt, and then dissolve away the support. A ring of thicker metal can be used to support the films, of which two and a half million would have to be piled to make a stack an inch high. Such films have been made of iron, nickel, gold, silver, and platinum, and it is found that although the nickel is much less transparent to visible light than gold, it readily transmits the shorter ultra-violet rays. The films are very elastic, and will bulge out for as much as a tenth of their diameter without breaking. Another curious thing about them is their high electrical conductivity. As these films are practically all surface, a strip of film containing no more metal than in a round wire one hundredth of a millimetre in diameter will carry enough current to light several lamps ; if the same current were passed through the wire the latter would be instantly melted. This film may find use in radio and phonograph reproducers, since ordinary diaphragms are so heavy that they dampen some of the overtones and so coarsen the sounds.

A New Aerial Cableway.—An aerial cableway, Gerschnialp-Trubsee, near Angelberg, Switzerland, was officially opened on 17th December 1927. The line is designed to carry both passenger and freight traffic by means of a closed car suspended from a cable between stations 2,235 metres apart and having a difference in elevation of 531·5 metres. A more elaborate cableway for commercial purposes and passenger traffic was erected about 20 years ago on the Wetterhorn in the Bernese Oberland, but its operation was discontinued several years ago because of the lack of passengers. The new line, near the summer and winter resort of Engelberg, having an altitude of 1,020 metres, is designed to increase the facilities of this resort for winter sports, as the town's elevation is not quite high enough to assure its having snow and ice throughout a mild winter. The upper heights of the mountains, with an abundance of snow during the winter months for skiing and other sports, are thus made very accessible to the hotels at Engelberg. The cableway consists of two parallel lines of suspension cables, each of which carries a car, one ascending as the other descends. A towing line is attached to the forward end of each car and connects with the power station at the upper terminus. The power plant consists of an a. c. motor, with a d. c. motor in reserve in case of the failure of the chief power unit. Both motors are equipped with electro-magnetic brakes which are automatically applied if the maximum speed of operation is exceeded, if the hawser should break, or in case the end station is overrun by the car. The brakes also can be applied by hand. Each car can accommodate 16 passengers and the conductor, and carry 150 kg. of baggage. The operating speed is approximately nine miles per hour, giving a maximum traffic of 65 passengers per hour in each direction, based on four trips per hour.

General Articles.

DEVELOPMENTS IN MODERN PULVERIZING PRACTICE.

MARKETS CAPTURED BY BRITISH ENTERPRISE.

THE keen attention which is being devoted to efficiency in all branches of Industry is a sign of the times. The economic circumstances of the moment compel the strictest scrutiny of production costs and as the key to many industries has hitherto been in plant and machinery of foreign manufacture, the subject demands the widest possible investigation.

The importance of the part played by pulverizing and grinding is seldom realised. It is in fact the principal operation in many trades, as for example the cement and plaster trades, pulverized fuel working, all branches of the chemical industry, paint, colour and pigment trades, asphalte and road work, ore and mineral working (which includes every branch of mining and metallurgical activity), fertilizers of all classes for agricultural purposes, fillers for the rubber, paper and textile trades, the manufacture of abrasives, etc., etc.

Until quite recently indeed, the art of milling or pulverizing, which had been almost entirely conducted on machines of American, French or German manufacture, had been very crude. The pulverizing business was in the hands of few firms, so that there was little incentive to improvement. Now, however, the position is altered. In spite of the post-war economic conditions which militated seriously against British manufacturers, the home produced grinding mill which combines cheapness in first cost, low maintenance charges and low power consumption with a very high standard of efficiency, is at last an accomplished fact.

Grinding machinery roughly falls into three classes—disintegrators, ball and ball and tube mills and pulverizers of the ring-roll type. Disintegrators of the swinging arm and beater type have the serious drawback of the excessively high speeds at which they operate (which is directly reflected in high maintenance charges), and the impossibility of producing the high "flour" content in the finished product which is so desirable. During recent years great strides have been made in the design of ball mills, all of which embody the same principles, even if slightly modified, relying as they do on the falling effect of forged steel balls on the material to be ground. The product when finished is discharged through a perforated screen or extracted by air separation. The power consumption is very high by this method, while the finished product is still too coarse. By the addition of a tube mill or finishing mill however, a product of suitable fineness can be obtained. This combination of a ball mill and a tube mill is found very reliable in operation, but has the serious disadvantages of occupying a very large floor space, while there does not appear to be much hope of obtaining any reduction in the very high power consumption per ton of material treated.

The most popular type of grinding mill for the reduction of all hard and refractory materials to powder is what is known as the ring-roll type of machine. In these, the grinding takes place between the faces of a number of rolls and a grinding ring. Over a period of many years machines of this pattern have met with a large measure of success and many plants are in operation where comparatively high efficiencies are being obtained in daily practice. All these mills, however, being dependent on centrifugal force for the crushing power obtained, have hitherto been designed along lines of extreme stiffness and absolute rigidity which has necessitated the use of large and costly foundations because of the excessive vibration to which their design rendered them subject. Further, this ultra-rigidity or as it might be termed, lack of flexibility, resulted in high maintenance charges which were further adversely affected by the high speeds at which they operated. In addition, the output from such mills is inclined to fall off as a result of the wearing of the grinding faces.

With a view to remedying these defects, the "Conquest" mill was evolved. This device, which is the product of the Conquest Mill Engineering Co., Ltd., of Craven House, Kingsway, W. C., is illustrated on the opposite page. In this machine the makers have aimed at isolating the grinding chamber from the drive by the inclusion of a device which absorbs the shocks and jars that arise from the reduction of all hard materials to powder.

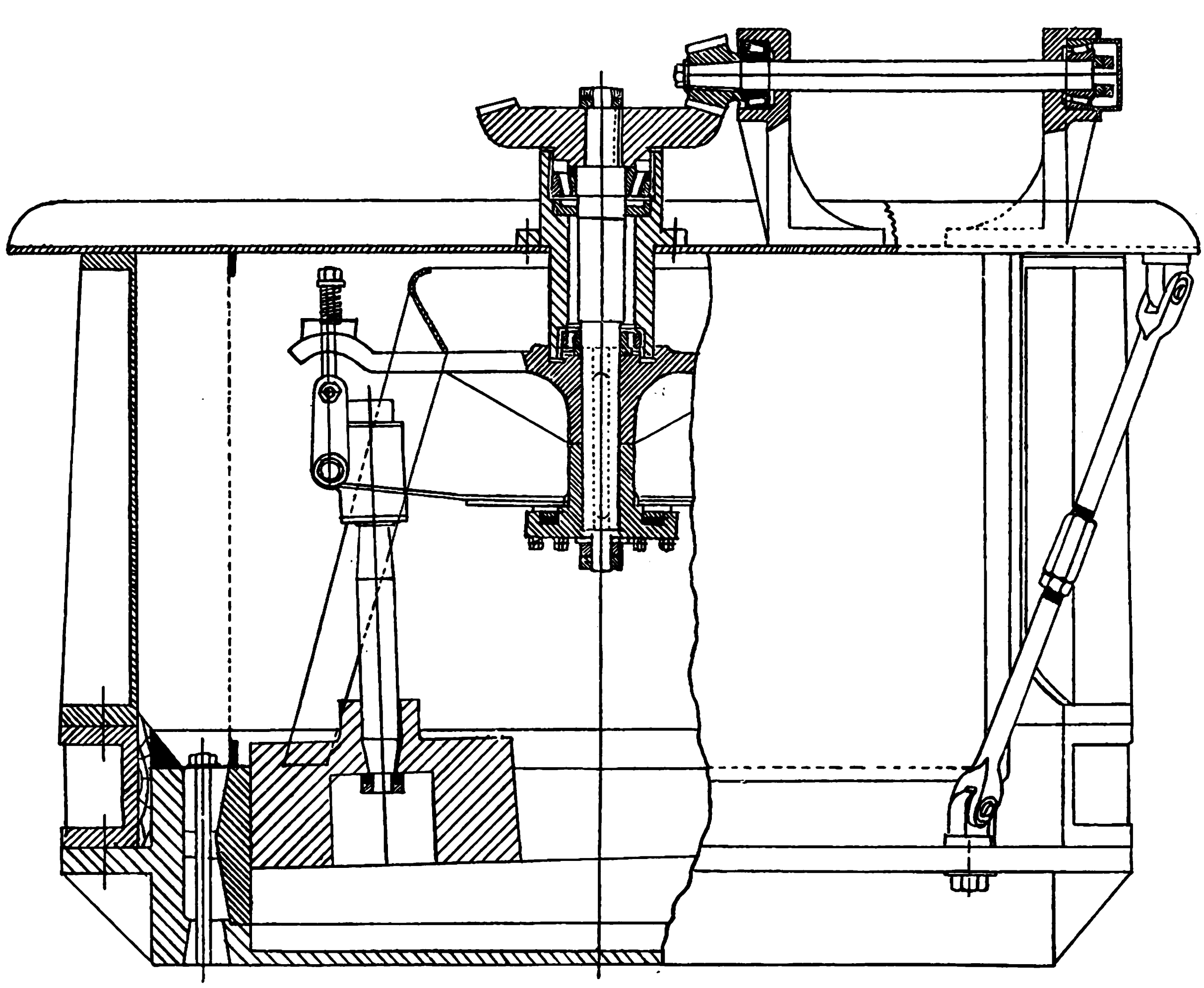
The "Conquest" mill is the result of more than 25 years' wide experience in grinding. For the two years prior to its being placed on the market, this mill was subjected to the most severe tests and there is nothing experimental about it. In addition, every part has been dealt with in detail by specialists—as for example the bearings, system of lubrication, the flexible carrier, the shafts and the grinding elements. As a result there has been produced a mill built on sound engineering lines and designed in accordance with up-to-date practice for long and satisfactory service.

In the "Conquest" mill a flexible carrier is used and from this is suspended the roll-heads and shafts. A "positive drive" is also incorporated which marks a great advance on grinding practice. The flexible carrier produces a slight rise and fall action on the roll-heads—an action which can be likened to that produced in a pestle and mortar, while pressure between the roll-head and the die-ring is due to centrifugal force alone and there is no added pressure as the roll-shaft is pivoted and free to move away from or towards the die-ring. A point to be stressed is that this centrifugal force is under control by the variation of the speed of the mill. A point to be noted also, is that the action imparted to the roll-heads eliminates the grooving of the die-ring which is so serious a trouble in other types of mills, while chipping of the roll-heads is also eliminated. As a result of the even wear and tear of the grinding faces, maximum output is maintained whilst maintenance charges are much reduced.

Bearing troubles which have hitherto proved so serious a difficulty in this class of machine, have been effectively eliminated, for "Conquest" mills are fitted throughout with Timken taper roller bearings which carry a two years' guarantee by the makers. These are carried in dustproof housings, whilst lubrication is by the "Tecalemit" grease gun system. This latter ensures efficient lubrication at all times.

Figures of recent tests would seem to show that these mills have proved very successful, since with a power consumption of 13 b. h.-p., the 30-inch two-roll type "Conquest" mill gives an output of one ton per hour on Midland coal to a fineness of 80 per cent. through a 200-mesh sieve. Other materials such as slate, granite, silica, oxides and pigments of various classes have also been treated with equally high efficiencies. It may be noted that on all these materials, a "flour" content exceeding 50 per cent. has been obtained. This is a factor of the utmost importance in the production of all pulverized products. For example, in one commodity treated in a "Conquest" mill, it was found that 52 per cent of the product was carried away on a vertical air column moving with a velocity of 60 feet per minute. This is a figure which the makers of this machine claim has never hitherto been reached.

In machinery of this class accessibility is of the utmost importance and here the "Conquest" mill reaches a high standard. It is also worthy of note that this machine supplies the finished product to any degree of fineness at one operation thus obviating the need for any auxiliaries such as screening or separating plant. To sum up, it is claimed that



—54 INCH CONQUEST MILL—

—4 ROLL TYPE—

DEVELOPMENTS IN MODERN PULVERIZINC PRACTICE.

this all-British mill shows considerable economy in first cost, maintenance charges and power consumption whilst it occupies but little floor space. From the users' point of view a detail of no less importance is the fact that maximum efficiency in operation can be obtained with entirely unskilled labour. The cordial reception afforded to the "Conquest" mill is very gratifying to those responsible for its introduction and serves again to prove that the high standard of British craftsmanship to which our commercial supremacy owes so much is still a very real factor in Industry and receives ready appreciation.

DEVELOPMENTS IN FUEL TECHNOLOGY.

AN INTERESTING EXHIBIT AT THE BRITISH INDUSTRIES FAIR, BIRMINGHAM.

(FROM OUR LONDON CORRESPONDENT.)

LONDON, *10th April 1928.*

IT is familiar knowledge that the advances made during the past few years as regards the treatment and utilisation of coal and other solid fuels are of an amazing character, especially as regards power generation. This was indicated in striking fashion by the Stand of International Combustion Ltd. of London, who have the steam power installation for the Perak Hydro-electric Station in hand, and their Associated Company, the Underfeed Stoker Co. Ltd. (Africa House, Kingsway, London, W. C. 2), at the Birmingham British Industries Fair, 29th February to 2nd March.

The International Combustion section of the Stand showed an improved design of pulverised fuel feeder, the new "R" burner, which is undoubtedly itself a great advance in pulverised fuel, "Murray-Usco" tubes and heaters, and the well-known "Raymond" centrifugal mill. Essentially the "R" burner is of the most modern turbulent type, with completion of the flame in 10 feet only, and operating with an air pressure of not over 2″ W. G., while requiring merely the simplest adjustment by means of one damper only. The nett result is that the combustion chamber can be cut down in size by about half, a vital matter for large power station equipment.

The Underfeed Stoker Co. showed portions of their well-known "Underfeed Travelling Grate A" stoker, parts of the remarkable new "Underfeed Type L" stoker, the "Usco" air heater, and the "Detrick-Usco" suspended firebrick arch, while in addition another of the firm's Associated Companies, Messrs. Coal Oil Extraction Ltd., had on view samples of low temperature tar from the "McEwen-Runge" process.

Undoubtedly the most striking item is the "Underfeed Type L" stoker, which has solved at last two of the most difficult problems in water tube boiler operation, that is to say, with the extremely wide combustion chambers now possible, because of the suspended firebrick arch, the automatic discharge of riddlings from travelling grate stokers and the absolutely uniform distribution of the forced draught air supply, both longitudinally and transversely, at every part of the grate. With all previous designs widths such as 15 feet and over have resulted in inefficient draught at the centre, while hand cleaning out or complicated discharge gear working in the heat has been necessary for the riddlings.

Perhaps the most interesting aspect, however, of the whole subject is the remarkable degree of efficiency that has now been arrived at both with pulverised fuel firing and mechanical stoking, which are running a neck-and-neck race for supremacy, and to-day we have reached the amazing stage that large water tube boilers will operate at 90 per cent. continuous efficiency either with mechanical stoking or pulverised fuel firing, corresponding to about 93-94 per cent. on ordinary tests of, say, 24 hours.

THE UNIVERSAL P. K. FORMULA.

III.

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FROM Table G the following further explains the primitive method :—

+ ·115895	+ ·110792	+ ·097896
− ·110792	− ·097896	− ·092353
·005103	·012896	·005543
− ·185135	− ·190238	− ·203134
+ ·190238	+ ·203134	+ ·208677
·005103	·012896	·005543

The log diff. $\sqrt{l_0}$ diminishes inversely as the log diff. $\sqrt{AQ}$ increases. At every stage of the calculation the two log diffs. added make log 2.

The question of variation due to shape of section, raised tentatively in article II, apparently does not arise; or else the error is immaterial.* The ruling factor is m and not d.

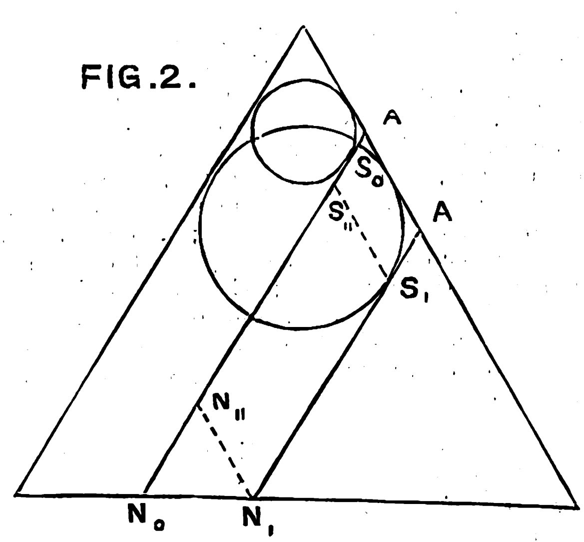
[The writer has already stated the advantages to be gained by using the factors f and y to condense tables.]

The reader will remember that the hydraulic law of the Pyramid was sought to strengthen the case for the Tripod in Weights and Measures. It has been necessary to employ methods which can be *satisfactorily* proved to have been known in ancient times. The writer thinks he has shown that the Pyramid engineers were in a position to design and construct canals and conduits as ably as their modern successors in the art, in spite of their primitive mathematics.

What is now required is an elegant modern mathematical demonstration similar to those of Newton and Kepler, to embody the substance of these articles from 1925. A master-mind is wanted; the writer doubts his own ability.† Going back to Fig. 1, another Fig. 2 will show roughly the desired solution. The triangle represents a section on the vertical axis of a right cone, with two parallel parabolas in the planes AS_0N_0

(AAN_0N_1 *is the Granite Boss.*)

FIG. 2.



and AS_1N_1 (compare with Fig. 1). The two circles are sections of the two respective inscribed spheres,

* More-accurate observations are needed, than available.

† To bungle the demonstration would be a crime.

within a cone of such angle that the points N_0 and N_1 fall in the plane of the base of the cone. Fig. 1 shows the plane of one parabola projected by points on the plane of the other parabola, the vertices A coinciding. Fig. 2 indicates the projections ; S_{11} and N_{11}.

The suggested demonstration would connect all cases similar to the above in a few simple but general equations, universally applicable, and without any special calculation, by the working engineer.

With reference to INDIAN ENGINEERING the issues dated 18th and 25th February 1928, "Factorization," the question of Consistent Series of V_0 and a constant l_p would appear to be a question of ONE particular case only :—

$$V_0 \sqrt{l_p} = 2m \sqrt{l_0}$$

$$\sqrt{l_0} = \frac{C_0 \sqrt{m}}{2m} \sqrt{l_p}$$

When l_p is a constant, and C_0 is also a constant :—

$$\sqrt{l_0} : \sqrt{l_0^1} :: \sqrt{m} : \sqrt{m_1}$$

The demonstration would show this very plainly. The writer has some idea that the **Spiral of Archimedes** has an important bearing on the solutions.

A few remarks on the necessity for a P. K. Formula in all hydraulic engineering may be useful.

The writer is not referring to cases of corrosion of iron and steel pipes due either to impurities in the metal or to the inimical presence of substances dissolved in the fluid conveyed. But there are instances of encrustations and of growth of algæ in metal pipes which puzzle engineers to account for. It is just possible that unsuitable values of C are responsible.

Again, concrete lining of earthen canals is expensive ; and an unduly high velocity will erode concrete in the same way that a much lower, but still unduly high velocity will erode earth. For irrigation reasons, canals follow watershed lines ; and natural causes limit the fall, even if lining be adopted. There may be a saving on masonry works ; but the lining is probably too good for its purpose. The use of the factor C would determine the material to be used for lining ; and there might be considerable savings in costs of material and labour. For example with a C not exceeding 2·500, it might be economical to use cheap bricks roughly laid in bitumen, with reeds in the jointing. Or simple broken clinker brick or *kankar* aggregate mixed with earth and lime, with a little *soorkhee*, the surface tar-sprayed if necessary. There is no object in spending more money than will just serve ; and the factor C would ensure uniformity of design and construction throughout a canal system ; C being adjusted to locality and silt-conditions, and probably a variable. A reasonable sinking-fund to cover cost of repairs and compensation for *temporary* stoppages of supply would do all the rest.

So far as he is concerned, Σ. Φ. has exhausted the subject of hydraulic flow and is not prepared to go further. The Canal Engineer and the expert mathematician must carry on the torch.

Σ. Φ.

January to March 1928.
Completed : 24th March 1928.

FINIS.

THE PRINCE OF WALES VISITS A MOTOR WORKS.

TO those closely associated with any factory the interesting features of the work carried on are rather apt, through mere familiarity, to be overlooked, as the tendency is to focus too much on one point, one's own particular work. The effect is similar to standing close up to a great picture.

This is demonstrated very clearly when arrangements are being made to show a distinguished visitor through the works. A walk through the various departments with one's eyes really open reveals a multitude of intensely interesting features, familiarity with which has bred, not contempt, but possibly indifference.

Thus the visit of H. R. H. The Prince of Wales to the works of the Albion Motor Car Co. at Scotstoun, and the keen interest he displayed in what he saw, emphasised anew the many striking features which form part of the everyday routine.

This Royal visit to the Albion Works took place on 4th November 1927, the first day of the Scottish Motor Show. The opening ceremony at the Kelvin Hall was performed by His Royal Highness in the afternoon, and his inspection of a large motor factory was, therefore, a particularly appropriate feature of the Prince's morning programme.

His Royal Highness arrived at 12-30, accompanied by a party which included Lord Weir, Air-Marshal Sir Hugh Trenchard and Brigadier-General Trotter, the Prince's Equerry. In the unavoidable absence of Dr. T. Blackwood Murray, the chairman of the company, the Prince was welcomed by Mr. N. O. Fulton and Mr. J. F. Henderson, directors. After the other directors had been introduced His Royal Highness started his tour of the works with Mr. N. O. Fulton acting as guide.

The Prince of Wales has a reputation for doing things thoroughly, and his inspection of the Albion Works was no mere formality. He was quick to grasp the soundness of the manufacturing system which is the result of 28 years' experience. His Royal Highness, as a result of his travels, is, of course, well aware of the exteme importance of road transport in the more recently developed parts of the world, and the difficulties with which motor vehicles have to contend in countries overseas, and was therefore particularly interested to learn that a large proportion of the Albion output has always been for the export markets, and that no fewer than 30 overseas Governments are users of Albion vehicles.

The drawing office, the various machine shops, the erecting and finishing-off shops were all visited in turn. His Royal Highness also spent a short time in both chemical and physical laboratories, where he actually carried out tests with some of the apparatus, and was given a demonstration of the power of the micro-camera, which photographs metals with a magnification of anything up to 1,500 times, an example of the minute care which is taken to see that Albion material is absolutely up to standard.

In the course of his tour the Prince chatted in his informal way with a number of the workmen.

After visiting the various departments His Royal Highness inspected a number of Albion models illustrating various phases of the company's history. These ranged from a street sprinkler ready for shipment to Bermuda, down to a 1901 "Dogcart" still in running order, which specially interested His Royal Highness. The Prince's attention was also attracted by an old 3-ton model similar to the 6,000 which were supplied to the War Department between 1914 and 1918.

While the Royal visitor was passing through the shops work went on as usual, but during his examination of the various vehicles the employees congregated in the fitting shop and the main hall, and made the roof re-echo with round after round of lusty cheering

So ended a memorable visit which was undoubtedly a striking recognition of the importance of the commercial motor industry, in which, as is well known, the Albion Motor Car Co. has, from the very first, played a leading part.

PERFECTING THE PLOUGHSHARE.

HOUSE OF RANSOME'S KEY TO GREATNESS.

INTERESTING reminiscences extending over a business life of sixty years were given at a representative meeting of the staff of Messrs. Ransome, Sims and Jefferies, Limited, recently, when a large number assembled in the Workmen's Hall to congratulate Mr. Charles Joseph Palmer on having reached the sixtieth anniversary of his commencement with the firm, whose finished products are as well known in South Africa as in England.

Handsome presentations were made, and Mr. Palmer, in the course of his interesting reply, said: "I have been continually meditating during the past few weeks on the causes to which is due the fame and greatness of the House of Ransome. I cannot go back to the beginning in my thoughts, but I can go back, as you know, a long way, and I have read much of the remainder.

I think you will like to know what, in my opinion, those causes are. In the first place, the greatness of the men who built, and who have now passed away. Then, undoubtedly, the invention by the founder in 1803 of the chilled share, which constituted perhaps the greatest revolution ever made in agriculture. Previous to 1785, all records show that the only share used in ploughing was the wrought share. Mr. Robert Ransome, then living in Norwich, made countless experiments to find some process by which shares could be made of cast iron, a much cheaper material, and kept sharp in work. In that year he patented a process for tempering cast iron shares, which had a partial success, and he advertised and sold his new shares widely to the farmers. A copy of the 'Norwich Mercury' for 23rd April 1785, containing a list of 50 people who stocked these shares in the counties of Norfolk and Suffolk is in the possession of the Company.

Mr. Ransome was not satisfied with these shares, which lacked absolute perfection, and worked away at the problem, which he solved in 1803, and patented his chilled share, which, soft in one place, and hard in another, was worn away gradually in work, retaining its sharp edge. Every day at the factory you will see these shares being made in hundreds, just as they have been continuously since 1803, and millions have been sold all over the world, this process of manufacture to-day being universal for cast iron shares.

The next great factor in the firm's prosperity was their participation in the railway boom of the '40's, '50's and '60's, when they made millions of their patent keys and trenails, and vast quantities of other railway material. A further factor was that they have always had a leading, outstanding plough before the public; in 1828 it was their wooden plough, the NL, in 1844 the YL, which swept the board of prizes at Southampton, and in 1864 the RN series, which took the leading prizes at Newcastle, and, since then, other great ploughs for home and foreign use. Further, the important inventions in the '60's and '70's of the straw-chopping-threshing machine, the Head and Schemioth straw-burning engine, and the patent lifting apparatus for ploughs. These all struck new ground and large demand, and are still in general use to-day.

A factor, too, was their consistent and lavish participation in the great international exhibitions, which, beginning with the 1851 Exhibition in Hyde Park, was followed by the Paris exhibitions of 1855 and 1856, and other vast exhibitions in the great capitals for thirty years. At all of these the firm obtained high distinctions, which made the name of Ransome ring throughout the world. Another factor was their attendance in heavy display at all the shows of the Royal Agricultural Society of England, beginning with the first show in Oxford in 1839, and continuing to the present day. They made a great sensation at the Oxford Show referred to, sending their goods, weighing six tons, a hundred miles by horses and waggons from Ipswich in the absence of a railway, and being awarded the gold medal of the Society, a great distinction.

Finally, the reputation of the firm has been strongly maintained by the fact that, from the early days, the partners have regularly travelled all the countries of the world, and had their experts year after year testing their machinery in the working conditions of foreign lands."

BRITISH ENGINEERING PROGRESS.

(BY A SPECIAL CORRESPONDENT.)

LONDON, *12th April 1928.*

BIG RAILWAY ORDERS.

THE greater activity enjoyed by the manufacturers of railway material last year is reflected in the financial results now being published. A number of the locomotive builders had been experiencing very lean times over a number of years and it is all the more satisfactory to learn that considerable orders are now being placed both for home and overseas.

Owing to the large amount of electrification work in hand all over the civilised world the makers of that class of railway machinery have, on the other hand, been kept busy, and there seems to be no falling off in orders. Some huge orders have been placed with British firms, as for instance, the contract secured by the General Electric Co. for the London Underground Railways, consisting in all of no less than 920 traction motors, each of 240 h.-p., as well as automatic acceleration control equipment for 63 motor coaches and 107 trailer cars. The original order was for a much smaller amount and was subsequently increased.

Repeat orders are the surest indication of satisfaction. Thus, the India Stores Department of Madras, after employing six Sentinel patent steam locomotives on the Cauvery-Mettur project for some time, placed a further order for 12 more locomotives of the same type. Again the Egyptian Delta Light Railway ordered 12 following 37 already supplied and giving satisfactory service.

In the same way the Sentinel-Cammell rail cars have made a great reputation for themselves. After using 24 of these the London and North Eastern Railway has placed a repeat order for a further 20, while the Ceylon Government Railway is adding 10 more to the 20 already in service.

IN SEARCH OF EFFICIENCY.

With the present fierce competition between road and rail transport, there has never in the history of the railways been greater need for the exercise of all possible methods of effecting economies than now. The tests, therefore, that have recently been conducted on the L. M. and S. Railway with the Beardmore-Caprotti poppet valve gear are of particular interest. In this gear poppet valves, similar to those employed in a motor car, are used to control the steam inlet and exhaust in place of the ordinary valve gear.

The results show that a Caprotti-fitted engine, as compared with one of similar type but fitted with ordinary link gear, gives very superior results in respect of coal economy, in fact the guaranteed figure of 10 per cent. is easily exceeded in actual running. For the L. M. and S. tests two 4-6-0 four-cylinder engines of the Claughton type were used.

While on the subject of efficiency, it is significant that increasing use is being made in the railway world of the Hollerith electrical sorting and tabulating machines for statistics and costing work of all kinds. These amazing machines have been aptly called "electric brains," and their capacity is certainly almost uncanny. It is claimed, for instance, that the amount

of detail which the Hollerith machines can give is ten times in volume and efficiency the production of a cost clerk working by hand.

The electrical tabulator is fitted with five counters which can be likened to five adding machines, each working independently and obtaining five totals at one operation. Forty columns can be added simultaneously and the machine is capable of adding 45,000 items per hour.

The system has for some time past been used extensively by the Indian railways with greatly increased efficiency and economy.

A Huge Station Roof.

Talking of India, the important railway junction at Lucknow now boasts what is probably the largest station roof outside Europe. Apart from being one of the leading cities of the United Provinces, Lucknow is connected by rail with Cawnpore, with its many industrial activities, Fyzabad and Bareilly. It is the headquarters, too, of a military division and possesses large workshops belonging to the East Indian Railway.

Bell's "Bigsix" corrugated asbestos cement sheeting was used throughout for the roofing. This material is, of course, well known for its heat insulating properties and immunity from the ravages of climate and insect pests such as the dreaded white ant.

An Unusual Freight.

Not long ago the railway lines between Middlesborough an the north-east coast, and Darlington had an unusual freight to deal with. At the time the giant Cunarder "Aquitania" was undergoing an extensive overhaul by John Thornycroft and Co. at Southampton, and it was decided to fit a new rudder. This was cast at Darlington, and, when finished, weighed 54 tons and measured 23 feet by 19 feet. Such dimensions being far outside the usual limits for railway loads, the whole track had to be kept entirely clear during the rail journey to Middlesborough, and other traffic was held up to ensure safe transit.

From Middlesborough it was shipped to Southampton and successfully fitted into place as just one of the items included in this immense overhaul. Previously the "Mauretania," which, incidentally, is still regarded as the most popular Transatlantic vessel, was overhauled by Thornycrofts and put into proper trim for another year's service.

New Ships and Methods.

On the North Atlantic service between Liverpool and Montreal the most modern vessels will be the four new cabin steamers being built on the Clyde for the Canadian Pacific.

The first of the new ships, the "Duchess of Atholl" has been built by William Beardmore and Co., and will shortly be ready for trials. Of 20,000 tons, the "Duchess" boats are almost identical in general disposition and finish. They are capable of 17-18 knots, burn oil fuel and are designed to give every possible comfort to their 1,600 passengers, whether cabin, tourist, third cabin or third-class.

On the subject of modern shipboard equipment, an interesting contention is put forward by the protagonists of electric arc welding, who maintain that the possession of arc welding plant and equipment aboardship, together with a trained operator in cases of emergency would render vessels to a great extent independent of shore repair shops.

Arc welding has made tremendous strides during the past few years and improved methods and materials are being introduced day by day by such firms as Alloy Welding Processes, Ltd. In fact it is only very rarely that any metal part cannot be repaired so that it is in as good a condition as it was before the breakage occurred. It is not only that small parts can be welded but there is no reason why a fractured crankshaft should not be satisfactorily welded or put into a condition which will enable the ship to carry on at a reduced speed.

Fractured tubes or boiler plates could be very easily made good, and in fact the advantages to be gained by installing welding plant are so great that it will certainly not be long before it becomes a part of the regular equipment of every ship.

Fighting Fire.

The use of asbestos suits for firemen is spreading steadily and Bell's United Asbestos Co., who have devoted a great deal of study to the question, have received a number of orders from public authorities overseas, including Brazil and Australia. A feature of this type of special clothing is that, besides being fireproof, it is sufficiently light and supple to allow the wearer to work comparatively freely. The employment of lightning fasteners makes it possible to put the suit on or off quickly.

Originally some difficulty was experienced in producing a suitable helmet, but in co-operation with Merryweathers, a thoroughly satisfactory type has been evolved. It is light and of the "crash" type, hooded and fitted with side "lightning" fasteners and eye pieces, together with oxygen tube to the mouth piece from a cylinder carried vertically by the wearer between the shoulder blades.

The Gazettes.

Bihar and Orissa, April 18, 1928.

Public Works Department.

Mr. C. S. Saunders, Executive Engineer, Dehri Division, is appointed to officiate as Superintending Engineer, Chota Nagpur Circle, *vice* Mr. F. A. Betterton, granted leave, or until further orders.

Irrigation Department.

Mr. C. S. Saunders, Executive Engineer, Dehri Division, is temporarily transferred to the Public Works Department (Buildings and Roads), from the date he is relieved of the charge of the Dehri Division.

Punjab, April 27, 1928.

Buildings and Roads Branch.

On transfer from the Lahore Sanitary Provincial Division, which he left on 16th April 1928, Mr. D. A. Howell, Executive Sanitary Engineer, took over charge of the Sanitary Circle of Superintendence, on 16th April 1928, from Rai Bahadur Amar Nath, Nanda, B. A., M. I. E. (Ind.), Sanitary Engineer to Government, Punjab, who proceeded on leave.

Irrigation Branch.

Mr. F. A. Farquharson, M. C., Executive Engineer, on transfer from the Punjab Irrigation Secretariat, which he left on 23rd March 1928, joined the office of the Superintending Engineer, 3rd Bahawalpur Circle, Sutlej Valley Project, on 1st April 1928 and took over charge of that circle on 3rd April 1928 from Mr. F. J. Waller, Superintending Engineer, who proceeded on leave. Mr. Farquharson is appointed to officiate as Superintending Engineer with effect from 4th April 1928.

Lala Mehr Chand, Assistant Engineer, attached to the Hakra Division, 1st Bahawalpur Circle, Sutlej Valley Project, took over executive charge of that Division on 12th April 1928, from Mr. G. H. Dundon, M. C., Executive Engineer, who proceeded on leave.

Mr. T. M. Bostock, Superintending Engineer, on return from leave, landed at Bombay on 2nd April 1928, joined the Lower Chenab West Circle on the 5th idem and took over charge of that circle on the 6th idem, from Mr. H. W. King, Superintending Engineer, who proceeded on leave.

Mr. W. P. Thompson, Executive Engineer, attached to the Lyallpur Division, Lower Chenab West Circle, took over charge of the Hafizabad Division, Lower Chenab West Circle, in addition to his own duties, on 7th April 1928, from Khan Sahib Khan Faqir Muhammad Khan, Executive Engineer, transferred.

Mr. F. A. Cooper, Temporary Engineer, on transfer from the Majithia Division, Upper Bari Doab Canal, which he left on 6th April 1928, took over charge of the Rasul Division, Lower Jhelum Canal, on the 15th idem, from Mr. R. K. Nariman, Executive Engineer, who proceeded on leave.

Lala Bishamber Das, Assistant Engineer, on transfer from the Jhang Division, Lower Chenab West Circle, joined the Ludhiana Division, Sirhind Canal, on 1st April 1928, on return from leave.

Mian Muhammad Fakhur-ud-Din, Executive Engineer, on transfer from the Hissar Division, Western Jumna Canal, which he left on 16th April 1928, joined the office of the Chief Engineer, Public Works Department, Punjab, Irrigation Branch, on the 19th idem and took over charge of the duties of the Under-Secretary (South) to Government, Punjab, Public Works Department, Irrigation Branch, on the same date, from Sardar Bahadur Sardar Prabh Singh, Executive Engineer, transferred.

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INDIAN ENGINEERING.

SATURDAY, MAY 12, 1928.

DEATH OF MR. GEOFFREY RANSOME.

WE regret to hear of the death of Mr. Geoffrey Ransome of the Stanley Works at Newark on Trent a son of the late Mr. Allen Ransome who was the founder of the Company which has long been acknowledged as one of the leading wood-working machinery manufacturers, supplying machinery for the mechanical conversion of wood to all parts of the world. The name of Ransome will be familiar to all engineers as that of a family which has a reputation in various mechanical engineering enterprises. The late Mr. Allen Ransome was by no means the first engineer of the group, but he was eminent in it inasmuch as he left the old firm of agricultural engineers at Ipswich, of which his father and grandfather had been successive heads, to start on an independent enterprise of his own. That was as long ago as 1855, and at first at Chelsea, then at Battersea, and finally at a site on the London and North Eastern Railway at Newark on Trent, the business grew and established a great name for the manufacture of machinery of certain special kinds. The firm was the first in the field with cask-making machinery, and now on the Thames and Medway alone the Ransome machinery turns out 12,000,000 barrels a year. The same machinery is used extensively on the Continent of Europe, in Burma and other places in the world. That, too, was only one branch of work, the Stanley Works specialised in all wood-working machinery; such as tree-felling and log cross-cutting machines; horizontal and vertical log band-saw machines; machines for making railway carriages and wagons; machines for railway sleepers; and for all types of re-sawing and planing; carpentry and cabinet-work; and many of the machines were specially designed for very rapid production. In India, the Ransome manufactures have been supplied to several of the leading railways of the country, to the Forest Department and to a large number of private users. Mr. Allen Ransome, an engineer of great inventive ability, laid down two maxims for himself, whatever the cost of production of machines he would have nothing but the highest quality, and if any other firm produced a superior machine he made it his business to manufacture a still better one. It was possibly due to these principles that the Allen Ransome Company secured so high a reputation.

Mr. Allen Ransome died at the age of eighty, after a life into which he had crowded an immense amount of work, and was succeeded in the chair by his eldest son, Mr. Lewis Ransome, who had previously been his father's works manager and managing director. On the death of Mr. Lewis Ransome some few years ago, his younger brother, Geoffrey, who had also been trained in the business, took his place. Mr. Geoffrey

Ransome was born in 1867, and was educated at Richmond School, Yorkshire, and at Cambridge. He was one of the most popular of men, an accomplished linguist, speaking several languages, and a very keen sportsman, excelling in polo, cricket, boxing and big game shooting. He served in several parts of the East, erecting wood-working machinery, and was six years in India with the Assam Railways and Trading Company at Dibrugarh. He had a very extensive knowledge of the timber and saw-mills conditions of India and the East generally, and also in South America where he studied machinery requirements. He was appointed a director of A. Ransome and Co., Ltd., in 1902, and had been chairman for about five years. His bright and cheery personality made him friends wherever he went, and he will be greatly missed at the East India United Service Club, of which he was a member and where he was a great favourite. We offer our very sincere sympathies to all members of the Ransome family in their bereavement.

PIONEERS OF WIRELESS.*

WONDERFUL as has been the great achievement of wireless, it is not something that was sprung upon us in a day or in any short space of time, and everyone is doubtless well aware of that. At the same time few of us appreciate how slow a process it was, and a new book, "Pioneers of Wireless," is most fascinating reading as showing how large was the number of labourers in the field of research during a period of three or four hundred years. It was Marconi who benefiting by the previous work made wireless an accomplished fact, but Mr. Ellison Hawks mentions among the notable pioneers 27 men of Britain, 19 of America, 9 of Germany, 8 of Italy, 7 of France, with some few of other countries. In fact, as Samuel Smiles said: "Rarely does it happen that any discovery or invention of importance is made by one man alone. The threads of enquiry are taken up and traced, one labourer succeeding another, each tracing it a little further, often without apparent result. This goes on sometimes for centuries, until at length some man, greater perhaps than his fellows, seeking to fulfil the needs of his time, gathers the various threads together, treasures up the gain of past successes and failures, and uses them as the means for some solid achievement." Wireless is an example of what Smiles said, there were many pioneers, though to Guglielmo Marconi fell the final honour.

Magnetism plays an important part in wireless, and the author begins with William Gilbert who in the reign of Queen Elizabeth published his famous book "De Magnete" and gave a lead. The discovery of the Leyden jar, which has a direct connexion with the fundamental principles of wireless, was later an important fact. Then there were the kite experiments of Benjamin Franklin; the discovery of current electricity by Luigi Galvani, after whom the galvanic battery was named; the valuable work of Alessandro Volta of the "voltaic pile;" the furtherance of the science of electro-magnetism by Hans Oersted, who won the Copley Medal of the Royal Society; and the mathematical analysis of electricity by André Ampère. Whilst Ampère was investigating into the behaviour of the magnetic needle, Dominic Arago was studying the state of a wire through which an electric current was transmitted on the same lines as Sir Humphrey Davy in England. William Sturgeon, a man of little or no education and the son of a shoemaker, then discovered the electro-magnet, an appliance that is the basis of nearly all the technical applications of electricity; and Joseph Henry, carrying the studies further, had in his hands the principle that afterwards made possible the Morse telegraph. His name is perpetuated in the "henry," the unit of inductance, in accordance with the custom of associating the names of eminent discoverers with electrical units. Thus "volt," called after Volta, is the unit of electric pressure; "ampère" is the term given to the unit rate of electric flow; the unit of electrical resistance is named after Ohm; and "farad" perpetuates the honour of the great Faraday.

Michael Faraday has been called the founder of electrical science. He too was of humble origin, the son of a Yorkshire blacksmith; but he was a genius, and Sir Humphrey Davy, when congratulated on his valuable discoveries, was wont to say that his best discovery was Michael Faraday. Faraday succeeded Davy at the Royal Institution as Director of the Laboratory, and two of his discoveries, now in everyday use, form the basic principles of the electric motor and the dynamo. Indeed, the fundamental principles of wireless may be said to have been based on his discoveries, although he himself had no idea that they would lead to communicating without wires. Steinheil suggested means of signalling without wires, and Samuel Morse, the inventor of the code that bears his name, was the next to experiment in that direction. Morse was a born inventor, and as a pioneer of wireless did much excellent work. The Morse alphabet, used in wireless to-day, is a tribute to the efficiency of the Morse code; and he demonstrated the fact that an electric current will travel as well along a cable laid through water as along an air line. The time was not ripe for wireless telegraphy, or he might have discovered it for he was on the threshold of the invention. Simultaneously with him, James Lindsay of Scotland was doing notable work, and a little later Alexander Bell invented the telephone, which greatly facilitated research in wireless communication. Amos Dolbear made many improvements in the telephone, and bv transmitting signals through space without wires very nearly forestalled Marconi. At that stage of progress it is interesting to note that Mr. W. P. Johnston, Electrician to the Indian Telegrah Department, and Mr. W. F. Melhuish, who succeeded him, both did valuable experimental work in India. But the first practical wireless system, actually used for commercial purposes

* Pioneers of Wireless by Ellison Hawks, F. R. A. S. Methuen and Co., Ltd., 36, Essex Street, W. C., London.

was that evolved by Sir William Henry Preece, F. R. S., at one time Engineer-in-Chief of the General Post Office in England.

William Henry Preece started life with the intention of being a civil engineer, and a very good civil engineer he would have been, but he decided to take electricity as his vocation, and filled many important appointments. In the course of his duties at the Post Office, he noticed many cases of the telephone picking up telegraphic signals from distant circuits, and his experiments led him to the conclusion that around the wire was a magnetic field extending uninterruptedly through the earth as well as through the air. Preece's system gave great promise, but it had its limitations, and was successful only over short distances. David Hughes then carried research a step further by demonstrating the existence of aerial electric waves; and he was followed by James Clerk-Maxwell, who showed that electro-magnetic action must travel through space at a definite rate in waves, and by Heinrich Hertz, who established the truth of Clerk-Maxwell's conception. The discovery of the Hertzian waves was a great step in advance, and it only remained to turn it to practical use for wireless communication. Onesti and Righi in Italy, Branly in France, Tesla in America, Popoff in Russia, and Sir Oliver Lodge in England were all hot on the track when Marconi appeared on the scene and succeeded in making transoceanic wireless an accomplished fact. On the 22nd December 1902, he sent a wireless message to King Edward at Buckingham Palace: "On occasion of first wireless telegraphic communication across Atlantic Ocean may I be permitted to present, by means of this wireless message transmitted from Canada to England, my respectful homage to His Majesty the King." Wireless transatlantic communication then became general.

The above in a very brief form traces the chain of events that led to Marconi's great triumph, and readers will find the story as told by Mr. Ellison Hawks most enthralling. William Gilbert published his "De Magnete" in the year 1600, and in 1902 the first transatlantic message was received in England. Matters have moreover not been idle in the last twenty-five years, Marconi is still only fifty-four years of age, and in 1924 his experiments were extended to cover world-wide ranges with success. The full potentialities of wireless are by no means exhausted, and low-power consumption, low capital costs and running expenses, and the beam system will doubtless before long cause wireless transmission to be both inexpensive and generally in use. Lately, too, has come the wonder of wireless television, and for the first time faces of people in London have been transmitted to New York, a distance of 3,000 miles. It is possible that in a few years television may be so perfected that it will be an ordinary event. The wonders of the future are likely to continue, but it is due to the pioneers whose work made the progress of the present possible that they should not be forgotten, and Mr. Hawks' book makes their contributions to the sum of knowledge very clear.

THE ENGINEER IN WAR.*

THE publication of Brevet-Major B. C. Dening's book, "The Future of the British Army," gives an indication of the way in which soldiers are now regarding the conditions of warfare. But for many centuries past the engineer has been a very important factor in military operations. The very fact that until a comparatively recent date the term "engineer" was only applied to a person whose business in life it was to direct engines and other weapons of war and to design and construct fortifications, roads, bridges and works necessary for military purposes shows that this was so. The word was not used for the designers and constructors of similar works in a civil capacity till the great John Smeaton in the eighteenth century called himself an 'engineer' and later a civil engineer. As long, however, as there was fighting, and there was always fighting going on, the engineer was required. Even when the weapons were merely clubs or spears or swords, there were ramparts, banks and ditches, to give the defence an advantage; then the attackers took to projectiles and the defence works were made still stronger to resist them; and whether projectiles or ramming machines on the one side or stout walls on the other, both were engineers' affairs. The introduction of firearms gave the attack an additional advantage, and the fortresses became more impregnable. Against smooth-bore muskets and cannon a fort could make quite a good show, but the attack then took the form of sapping and mining, and again whether one or the other it was the engineer who was a prominent feature in the warfare. Firearms improved out of all recognition, breech-loaders, immense guns, explosive shells, made so great a difference that fortresses were no longer of any avail. Heavy howitzers demolished masses of concrete, revolving cupolas, armour plating, and there was a return to earthworks defended by magazine rifles and machine guns. Whatever the situation, the engineers continued to invent, and they invented the tanks.

The great war, Mr. Lloyd George once said, was an engineer's war. So it was; by sea, battleships, submarine and anti-submarine measures; in the air, aircraft and anti-aircraft; on land, tanks and other mechanical contrivances; the engineers, civil not military engineers, were always to the fore, and always the nation with the best engineers will have an inestimable advantage. In the early days of warfare the engineers were valuable, and in modern days they are still more indispensable. Brave as are our soldiers, sailors and airmen, they must be provided with the machinery for their purpose. It is no good a man being a fine horseman if he has not got a horse. In that aspect, Major Dening appraises the situation correctly. Success in war will attend the nation which is most advanced in scientific equipment, and the Major's army of the future is a mechanised army. It will be a smaller army, because just as production by machinery in factories needs fewer hands than production by hand-labour, so in a mechanised fighting force

* The Future of the British Army. By Brevet-Major B. C. Dening. (Witherby, 10s. 6d. net).

the same work will be done by a smaller number of men. Tanks proved to be very successful in the last great war, and Major Dening in the composition of his army would have tank battalions, and all movements would be by very mobile mechanical vehicles. He works it all out in figures to his own satisfaction, and shows that it is an economical proposition. The only criticism is he bases his proposals on the happenings of the last war, and the next war is likely to see many changes. The longer it is delayed, the greater will be the changes and overwhelmingly greater will be the power of destruction. Science is moving so rapidly that however wisely an army programme may be framed, a short span of years will cause it to be out of date. But whatever the shape that future warfare may take, it is certain that scientific engineering will be the main factor in it. It will be a case of engineers and engineers and engineers always.

STEEL-FRAMEWORK STRUCTURES.

It is a principle of good architecture that the materials of which buildings are constructed should express themselves. For instance, the old half-timbered houses of the Tudor period were very picturesque, and besides being picturesque they represented a definite form of construction in that the exposed oak timbers were really structural timbers. But now it is quite the fashion to construct buildings in which the exposed oak is a sham, and though the picturesqueness may in that way be obtained it is obtained by fraud. It is not desirable to have that pseudo old-worldery. We want materials to express themselves honestly and not to be imitated. We do not want corrugated iron in roofs painted to simulate tiles, plaster painted to simulate brickwork, brickwork painted to simulate stone, or any of the other abominations. It has the defect that it is not only a fake but the mellowing effect of time is lost. It is for that reason that the literature on the subject of the proper expression of ferro-concrete has been so extensive. Ferro-concrete has been brought more and more into use for structural purposes in past years, and it has been mainly an engineer's material, not an architect's. For a long time its use was principally confined to bridges, warehouses, factories, tall buildings, and it met a modern demand, the demand for high buildings with a maximum of internal space, capable of being constructed with economy of labour and with great rapidity. But it was never admitted that reinforced concrete was unsuitable for ordinary domestic architecture, it was only contended that architects, wedded to tradition, would not stir themselves to discover a means of expressing a material which has no old traditions to offer as a guide. The question was therefore one of using the special qualities of a new material in such a way as to arrive at a satisfying architecture, and using it honestly and not dissembling, as if it were a material antagonistic to an architect's ideals. Of more recent days, however, some advance in the desired direction has been made, and the works of the Perret brothers in France are typical examples of buildings, not merely constructed of reinforced concrete but designed in terms of the material, its special qualities, advantages and limitations. So that it can be said that as far as ferro-concrete is concerned architects are on their way to solve not too easy a problem.

But now another question has arisen, and it has been asked what is a proper expression for the buildings constructed of some material covering a steel skeleton? This is a form of construction which is now very much in vogue, it is more common than reinforced concrete, the real structural part of the construction is the steel framework, a framework of vertical and horizontal steel members bolted and riveted together, and eventually this skeleton is hidden by a veneer of some other material which may be stone, brick or anything else. To say what expression should be given to this method of building is impossible, there is no new material, as in the case of ferro-concrete, to express, and there seems to be no reason why the skeleton should affect the external design. The method implies no combination of the steel and the veneer, it is brought into use solely for economy and rapidity of building, and the steel frame once erected the architect can cover it with a material in any style of architecture fancy or the locality demands. When the foundations of the Victoria Memorial at Calcutta sunk and caused some alarm as to the ultimate stability of the superstructure, the engineers appointed to advise recommended a steel skeleton in order to reduce weight and to ensure more uniform distribution of the loads, but without in any way affecting the external appearance of Sir William Emerson's design. The Memorial was not built in that way, though possibly it would have been better to have followed the advice of the engineers, the structure was nevertheless strengthened with a very considerable amount of steel to protect it against the menace, and of course without affecting the general design. The use of steel, whether in the form of an independent framework or in other ways, then becomes a mode of building to the intentions of the architect's design, but not the design itself in a new material which calls for self-expression, and the question as to the manner in which it should influence external design would not appear to arise.

Books by Mr. W. L. Strange.—We invite the attention of our readers to the new advertisement in this issue of Mr. Strange's three books, inserted on the occasion of the publication of the third edition of "Indian Storage Reservoirs," which has been thoroughly revised and re-set. Compared with the first edition which was published in 1904 at 21*s*., the third edition has been increased by 142 pages to 506 net, by 6 figures in the text to 63, by 3 plates to 17, and by 2 appendices to 28, and its price to 25*s*. The book is so well known in India that all we need say about it is that it is self-contained and describes everything necessary for the design and construction of reservoirs with earthen dams. Copies of the combined prospectus of the three books can be had on application to this journal.

INDIAN PATENT RIGHTS.

NOTICE is hereby given that the Proprietors of Indian Patent No. 10736, dated 8th March 1924, for **"Improvements in or relating to means for the manufacture, centrifugally, of pipes, columns, and other hollow articles,"** being desirous of exploiting the same in this country, are prepared to grant Licenses for the working thereof in British India on reasonable terms. Full particulars may be had on application to—

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21, Old Court House Street,
Calcutta.

Notes and Comments.

Sandalwood Forest in Mysore.—Investigations have revealed the existence of a thick sandalwood forest amid the impenetrable jungle regions near Kankanhalli. The Chief Conservator of forests, Mysore, estimates that 600 tons of sandalwood, valued at Rs. 6 lakhs, are obtainable from the forest. He asked for Rs. 10,000 for the collection and transport of the wood and the Government have agreed to the expenditure.

Increase in Strength with Age.—It is announced that the new reinforced concrete Border Bridge over the Tweed at Berwick is not to have an official test before it is opened on 16th May by the Prince of Wales, as it is considered perfectly safe. It is estimated by engineers that the bridge will bear a weight of 1,000 tons per square foot at the present time, and when the concrete is older some 2,400 tons to the square foot.

Hume Reinforced Concrete Pipes.—It is understood that Hume Reinforced Concrete Pipes are to be used on the Chaziddin Hyder Canal Sewers, Lucknow. Over 17,000 running feet of 24-inch diameter pipes will be used and it is further understood that Captain Abbott has secured seven and a half acres of land in Lahore for the erection of a large factory where these pipes will be made. The whole scheme is to cost over four lakhs of rupees.

Messrs. Henry Pels.—This well-known firm of 32-38, Osnaburgh Street, London, N. W. 1, have sent us a copy of their list and leaflets. It is needless to remark that the name of Pels stands as a hall-mark for presses, punches, shears, croppers, notchers, guillotines, beam benders, etc. Pels' products are copied by many but equalled by none. They stand in a class of their own for design, workmanship, robust strength, and a permanent guarantee is attached to the armour plate frames.

Acknowledgments.—Our thanks for the receipt of the following magazine and reports:—The Agricultural Journal of India for the month of March 1928. Bengal Public Health Report, by Dr. C. A. Bentley, M. B., D. P. H., D. T. M. and H., Director of Public Health, Bengal. Reports of the Bengal Sanitary Board and the Chief Engineer, Public Health Department, for the year 1926. The Report for the year 1927 on the working of the Indian Boilers Act V of 1923 in the United Provinces.

Longest Non-Stop Run.—The longest regular non-stop railway service in the world between Kings Cross and Edinburgh, a distance of 392½ miles, was started on the 1st instant by the London and North Eastern Railway. The train is drawn by an engine of new design with a corridor connection to the footplate, allowing reliefs to take over the control when half the journey is completed. The new train contains a dressing saloon, a waiting room, ladies' retiring room and an electric kitchen.

Irrigation in the C. P.—The Administration Report of the Irrigation Department in the Central Provinces says, as was the case in the previous year, good progress was made in 1926-27 on construction, but the development has again been disappointing. The area irrigated has decreased from 443,064 acres due entirely to the unsatisfactory development of irrigation of rice from the Mahanadi canal and there has been an increase in the area of wheat, garden crops, sugarcane and other *rabi* crops. No new works were undertaken.

Road Oils (India), Ltd.—The Directors of Road Oils (India), Ltd., announce that during the last six months four million square feet of roads in India have been surfaced with "Mexaco," a road dressing which the company manufacture at their Calcutta and Bombay factories. The Directors believe that the developments now taking place in road construction and repair in all the provinces of India will lead to the increased use of scientific surfacing and they are pleased to report the success which has attended the efforts of this indigenous enterprise, whose processes are protected by Government Patent rights.

Huge Power Scheme.—A project for the large scale provision of electrical power for Hungary that will cost £3,000,000 has been formulated, and two public issues to meet the cost will shortly be made in London. One of these will be the guarantee of the British Government under the terms of the Trade Facilities Acts. The new scheme aims at effecting fuel economy by building a large generating station designed to use low grade coal produced locally. Budapest and other towns will be supplied with electric power from this station. Orders for British works arising from the scheme have been placed to the value of £1,000,000.

Railway Signalling.—The Signal Engineers' Committee of the Indian Railway Conference Association is now sitting in Simla, under the chairmanship of Mr. C. W. Parsons, Deputy Chief Engineer (Signals) of the East Indian Railway, to discuss various technical questions in connection with signalling on railways. The following officers are attending the meeting:—Mr. C. W. Parsons (E. I.), Mr. R. M. Edey and Mr. W. H. Haykes (B. B. and C. I.), Mr. W. R. Bennet (E. B.), Mr. V. H. Liley (G. I. P.), Mr. G. W. Ford (M. and S. M.), Mr. H. L. Rose (N. W.), Mr. W. D. Stubbs (B. B. and C. I.) and Mr. C. V. Bliss (Secretary of the Conference).

Bengal River Surveys.—In connection with the survey of the rivers Bidyadhari, Peali and Matla, the Calcutta Corporation will shortly be asked to sanction the retention of the staff of the new motor launch "Mermaid" up to the end of February 1929. As the river survey work has now proceeded further down, covering the wider reaches of the Peali and Matla rivers, it is essential that a strong and seaworthy boat like the "Mermaid" with full staff should be maintained for sounding work and general inspection of waterways in these reaches. It is not possible to take any soundings in the Matla below Golabari Gang with ordinary country boats as the rivers are too wide and rough. No attempt has yet been made to sound the lower reaches of the Matla river and those reaches are therefore uncharted so that the location of shoals and channels are not known.

B.-N. R. Local Advisory Committee.—At the 16th meeting of the Bengal-Nagpur Railway's Local Advisory Committee, held at Calcutta on 4th May, the Agent (Chairman) informed the members, that in response to their request, a waiting room for inter-class passengers would be provided at Midnapore. In

regard to a suggestion that the present Howrah-Gomoh fast passenger train should be converted into a Howrah-Purulia train, as Purulia was a more important place, and should have a through train-service, the Chairman stated that he could not agree to it, as the Gomoh train was fulfilling a definite need in serving important colliery areas. A complaint was made to the effect that the Bengal-Nagpur Railway carriages were "uncomfortable to travel in, compared with the G. I. P. or the E. I. Railway carriages." The Chairman informed the members that that was the first occasion a complaint of that nature had been brought to his notice, and he could not admit that the B.-N. Railway carriages were in any way inferior to those of the other railways. In that view, he was supported by the other members of the Committee.

Modern Steering Methods.—One of the principal features of the Shipping and Engineering Exhibition held in London last autumn was the exhibit showing various applications of the Hele-Shaw Beacham gear. The Hele-Shaw Beacham gear consists of two elements—a pump and a hydraulic motor. The pump is coupled up to the source of power and the hydraulic motor to the work, the hydraulic power being conveyed from the pump to the motor by short steel pipes. Usually the pump is made of variable and reversible stroke, while the hydraulic motor is of fixed stroke, the combination of the two being an infinitely variable and reversible gear, applicable to the numerous purposes in engineering practice where such a gear is required and where the source of power is in itself not sufficiently flexible to accommodate itself to the range of speed or effort by the work.

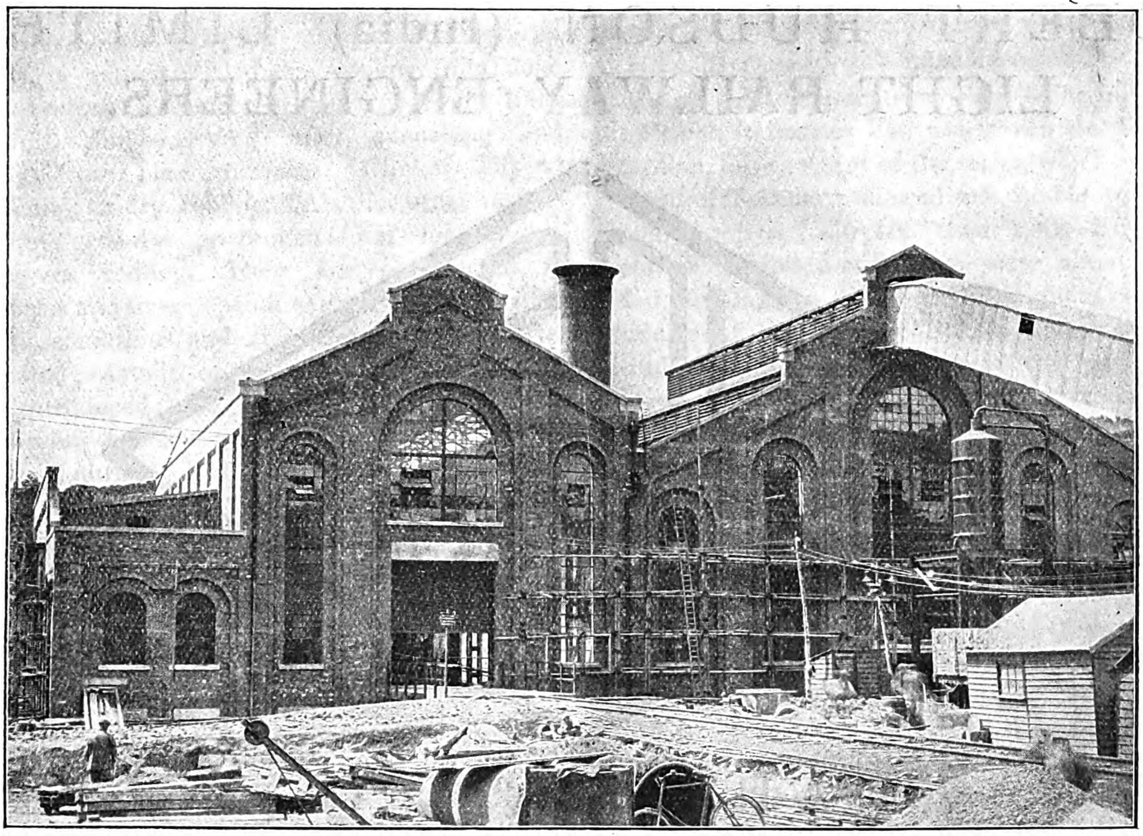
Calcutta Tramways Extension.—The extension of the Calcutta Tramways Company's system in Main Sewer Road is nearing completion, and it is proposed to open the new line in the first week of June. Roughly in the shape of the letter "S", the line will run from Ballygunge station along Gariahat Road, pass Lake Road, link up with Russa Road South as far as Kalighat and proceed along Judge's Court Road to Esplanade. Approximately the new line is about two miles in length, and the Calcutta Improvement Trust have undertaken its construction. South Ballygunge and North Gariahat will be opened up by the new line, which will afford direct access to the city for people living in the Diamond Harbour and Canning sections of the Eastern Bengal Railway. From Ballygunge station up to Russa Road South there is a wide grass track in the centre of the road along which the new line will run.

Hold-up on British Railways.—It was no alarming matter that led to the recent hold-up of traffic on certain British railway lines as our caption above may at first suggest, it was just one of the incidents in connection with the extensive overhaul of the giant Transatlantic liner "Aquitania," by Messrs. John I. Thornycroft and Co., Ltd., at Southampton. Following the survey of the vessel when she was high and dry in the 60,000-ton floating dry dock it was decided to fit a new rudder. This was cast at Darlington and when finished weighed 54 tons and measured 23 feet by 19 feet. These being far more than the usual limits for railway loads, during the rail journey to Middlesborough the whole track had to be kept entirely clear and other traffic was held up for several hours to ensure its safe transit. From Middlesborough it was shipped to Southampton and successfully fitted into plates as just one of the items included in this immense overhaul. Previously the Cunard liner "Mauretania" had been overhauled by Thornycrofts and this famous ocean grey-hound, the fastest in the world, put into proper trim both inside and out for another year's service.

Masonic Temple Built to Last Through the Ages.—The George Washington Masonic National Memorial now under construction at Alexandria, U. S. A., is noteworthy for the general massiveness of its construction and for the steps which are being taken to ensure that the memorial shall remain in place for thousands of years. The memorial, designed as a temple, faces east and is located upon the summit of a hill. The main structure, 225 feet long by 164 feet wide and 104 feet high, will be surmounted by a series of four successively smaller temples each designed in classic architecture and the building will ultimately rise to a height of 333 feet. Constructional materials of the most enduring type have been adopted, reinforced concrete faced with granite being employed for all the structural parts. All outside walls are 2 feet 6 inches thick in the lower tiers and 2 feet thick in the upper tiers, whilst walls 4 feet in thickness are used to support the tower. A large hall will occupy the entire central area of the main structure beneath the tower and the other portions of the building and the upper floors in the tower will provide lodge meeting rooms, library, miscellaneous rooms and offices.

Railways in South India.—The Madras and Southern Mahratta Railway and the South Indian Railway have been engaged for some time past in extending the railway facilities of Madras. Not long ago, His Excellency the Governor performed the inauguration of the Virudhunagar-Papanasam Railway on the South Indian Railway, thus reducing the distance to Trivandrum by four hours on the time unit and about 100 miles on the distance unit. The South Indian Railway Company are constructing two more lines which are expected to be ready shortly. A grand chord line between Villupuram and Trichinopoly, saving over 100 miles and more than four hours and a half to Colombo passengers, is practically ready, only a huge bridge being still uncompleted. Until the bridge is ready the company has decided to throw open to the public those parts of the line which are already complete, His Excellency the Governor performing the opening ceremony on 22nd June. Similarly, the Dindigul-Palni line also will shortly be ready. The Gudivada-Bhimavaram line, on the M. and S. M. Railway, is also complete, and the first train will run on the track shortly. This line will link the cotton-producing districts in the Madras Presidency.

Fuel Engineering Ltd.—This firm of Parliament Mansions, Victoria Street, Westminster, England, have placed on the market their "F. E." Patent Vertical Gravity Dryers, Pre-heaters or Coolers. Their different uses are as follows :—Coal—Drying for pulverizing, pre-heating for coke ovens, carbonizing, briquetting, and combustion in metallurgical, etc., furnaces ; also steam boilers—stoker fired. Ores—Drying for milling or furnace treatment. Stone—



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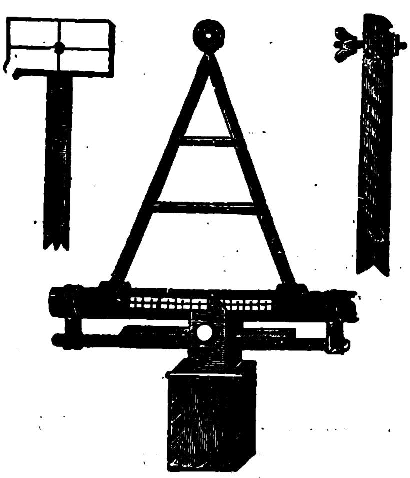

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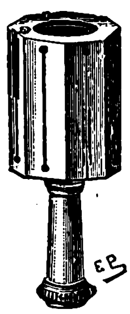

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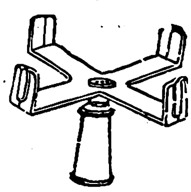

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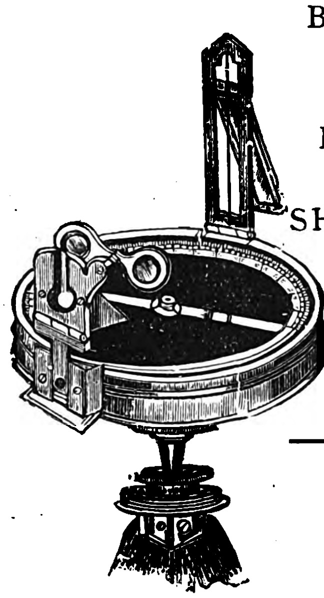

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A Steam Wagon that Saves Time and Money.—We are indebted to "El Mercurio" of Santiago for the following account of how the collection of refuse is now being carried out in that city. "Yesterday we had an opportunity of observing the manner in which the collection of refuse is actually effected, as well as the splendid results yielded by this new system which has come to oust completely the system hitherto in use. The Sanitation Department of the Santiago Municipality recently ordered the construction of a series of covered bins, of large capacity, for the collection of refuse. These bins are conveyed in a small cart drawn by a mule, which goes from house to house collecting the refuse, and when full these bins are left at the street corners to await the wagon which is to convey them to the refuse destructors. Yesterday, happening to be in the Avenida Brasil, at the corner of San Pablo, we saw the arrival there of a magnificent 'Super-Sentinel' steam wagon. The wagon stopped at that corner and the two men in charge got down. A small crane located on the wagon was brought into operation, and the refuse bin was hoisted and placed on the platform of the wagon, whereupon, the 'Super-Sentinel' departed smoothly and at a uniform speed for the next corner, where the same operation was repeated for the collection of another refuse bin, and so forth until eight bins were collected. The wagon then set off rapidly in the direction of the refuse incinerators located on the banks of the Mapocho, in the vicinity of the 'Estadium Policial.' Immediately on arriving there, the wagon took up its position on a platform beneath a kind of bridge, on which several pulleys were to be seen. Then employees from the Sanitation Service quickly mounted the wagon and proceeded to suspend each of the bins to the hooks of the said pulleys and to hoist them carefully. As soon as the bins were raised, the 'Super-Sentinel' wagon left the platform and departed rapidly in search of further bins full of refuse. Then, by an operation occupying no more than five minutes, the bins are discharged into the incinerators, which are working at full capacity and with splendid results."

At the British Industries Fair.—The importance of the British Industries Fair has grown steadily since its inception, but the 14th of the series, which was held at the end of February, showed remarkable progress over previous years. No less than 2,000 British manufacturers exhibited and there were about 12 miles of stand frontage. At the Birmingham section the products of the heavier British trades were shown, including wide representation of the engineering industry. Amongst firms whose products are already well known in the Overseas markets was that of R. A. Lister and Co., Ltd., of Dursley, Gloucestershire, who were showing three of their chief manufactures—petrol engines, electric lighting plants and auto-trucks. Lister engines have gained a deservedly high reputation in the world's markets. As a result of extensive research and experiments, "Ricardo" patent cylinder heads have now been adopted, resulting in a marked increase of power. The ever-increasing demand has, too, enabled the new sizes to be listed at the prices of the lower-powered models which they replace. The range of engines now extends from 1½ h.-p. to 20 h.-p., and is suitable for all kinds of agricultural and industrial purposes. Owing to their rigid construction and the fact that they are totally enclosed, the 16 and 20 h.-p. engines, for instance, are particularly suited to work under dirty or exposed conditions, such as stone crushing and concrete mixing and driving heavy machinery, including threshers. The electric lighting plants shown were two non-automatic types of 1 kw. and 1½ kw., respectively, actually shown in operation, while a fully automatic 3-kw. set was also exhibited. Extremely simple to operate, compact and easily installed, these plants form the ideal solution to lighting problems for dwelling places or farm and outbuildings. Further, they can be used for operating many domestic labour-saving electric appliances. It speaks volumes for the plants that, despite tariffs, they are exported to America in considerable numbers. The Lister auto-truck, a comparatively new comer, has, however, been established long enough to become one of the firm's leading manufactures. It undoubtedly provides a highly efficient means of transporting merchandise of all descriptions. Driven by a petrol engine, it can be used continuously, day and night, if desired. No battery is used, so that there are no delays for charging. It is built to carry 1 ton, and is easily handled in confined spaces, for it may be completely turned in a radius less than its own length. Various bodies can be fitted to suit any particular trade requirement. The list of users of the auto-truck is an imposing one, including as it does the leading British railway companies and a large number of well-known industrial concerns, such as Baldwins, Ltd., Associated Daimler Co., Morris Commercial Cars, Ltd., Metropolitan-Vickers Electrical Co., Ltd., Austin Motor Co., Singer and Co., Ltd., and many others. Overseas it is becoming increasingly popular, and is employed by the Buenos Ayres Western Railway, Royal State Railways of Siam, the Hongkong Tramways, and in India, Australia, New Zealand, South Africa, Canada, as well as in many European countries.

Current News.

MR. H. L. GLASS, Executive Engineer, is appointed to officiate as Deputy Agent, North Western Railway.

THE new bridge over the Thames between Windsor and Datchet was formally opened by Sir Wm. Mount on 5th April.

THE Bally Municipality has decided to sink 16 tube wells to meet the scarcity of drinking water in the area under its control.

THE competitive examination to select candidates for training for the Indian Forest Service will be held at Delhi in August next.

THE work in connection with the installation of electric lights on the municipal roads at Bally will, it is understood, be completed by July.

MR. A. JOHNSTONE, Engineer-in-Chief, Bally Bridge Construction, is on a short visit to Simla for a conference with the Railway Board.

IT is officially announced that the new French cruiser "Tourville," of 10,000 tons, attained a speed of 36·07 knots during her trials in the Bay of Biscay.

THE Bangalore District Board is considering the possibilities of the Bangalore-Hosur Railway extension and the practicability of levying a railway cess thereon.

OF the four vessels now on the stocks at the Maisonnœuvre yard of the Canadian Vickers Company, near Montreal, one is a motor ship, which is to be launched this month.

THE Railway Rates Inquiry Committee has concluded its sitting at Delhi and will leave for Simla. The Committee will occasionally visit Delhi for the disposal of pending cases.

IT is proposed to construct a submerged masonry bridge over the Nerbudda River at Tilwaraghat to serve the Great Northern Road, connecting Jubbulpore with Nagpur in the Central Provinces.

THE total approximate gross earnings of State railways up to 21st April 1928 amounted to Rs. 6·49 crores, or Rs. 27 lakhs more than the figures for the corresponding period of the previous year.

THE Mettur scheme of the Government of Madras is likely to involve a further expenditure of Rs. 125 lakhs. The Government estimate a net revenue of Rs. 54 lakhs ten years after its completion.

THE latest official estimate of the output of minerals from Canada for 1927 shows a value of 244,520,098 dollars, which represents an increase of over 4,000,000 dollars during the twelve months.

THE Kwantung Government has decided to construct a large reservoir with a volume of 15,000,000 tons of water between Dairen and Port Arthur, at the cost of £555,700. Work is expected to be finished in five years.

THE extension of the synthetic ammonia works at Billingham-on-Tees will involve the supply of 45,000 tons of structural steel by Dorman, Long and Co., Ltd., and 2,200 tons of steel, for the new boiler-house by Redpath, Brown and Co.

TOWARDS the end of February the power station at Yallourn, Australia, achieved a record with an output of 61,000 kilowatts. The normal rating of the plant is 50,000 kilowatts, but it is being extended by the addition of another 12,500-kw. set.

THE headquarters of the "T./N." (Tunnel North Portal) Subdivision of Tunnel Division, P. W. D., Hydro-electric Branch, Punjab, have been transferred from "Tunnel Exit" (Old Shanon Area) to Winch Camp from 1st December 1927.

THE first two completed submarines of the Jugoslav Fleet have arrived at the port of Attaro. The two submarines were laid down by Armstrong, Whitworth and Co. in 1926. They carry two 4-inch anti-aircraft guns and six 21-inch torpedo tubes.

THE total approximate gross earnings of State railways for the week ending 21st April 1928 amounted to Rs. 215 lakhs, Rs. 2 lakhs less than the figures for the previous week, and Rs. 5 lakhs more than the figures for the corresponding week of the previous year.

MR. J. COUPER DAVIE has been elected by the Calcutta Trades Association to be a Commissioner for the Port of Calcutta, *vice* Mr. J. H. Wiggett, who has been permitted to be absent from the Commissioners' meetings for seven months with effect from 17th March last.

WITH a view to accommodating the present astronomical observatory of the Presidency College, Calcutta, a new building is under construction on the west of the main building of the college. The work which is to cost Rs. 40,000 is expected to be completed in the course of this month.

COLONEL PERCY ROTHERA, presiding over a meeting of the South Indian Railway Advisory Committee, at Ootacamund, declared that proposals for the reduction of fares of all classes were under the Company's consideration. He added that concession rates to convey paddy seeds at one-fourth of the parcel rate, was also being considered.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

MALARIA AND IRRIGATION.

SIR,—Bengal has one splendid lesson to teach all India. Malaria and the coloured water of river floods are sworn enemies. Now this coloured water is more deeply coloured in the early days of the floods than in the later days, and these early days are the critical ones in the life of mosquitoes. Irrigation Engineers have therefore an edged weapon to fight malaria with. Clear rain water and clear water which oozes up with the rise of spring level from below are the friends of mosquitoes, just as coloured water is the enemy. Early flood water could combat malaria. The Irrigation Department in the Punjab, in my birthplace the Western Doon, and in countless other places could, in the interests of Public Health, allow full supplies of early flood water to flow down the canals and be given free for the first six weeks of the monsoon to everybody who could take it and let it mingle in the fields with the rainwater of the monsoon. This would help to combat malaria and enrich the soil and be a kind of tithe given to God. This flood water coming from above would not hurt spring level. It is the water entering the soil through leakage into the subsoil from canals and distributaries, which comes up from below, which hurts the land. This rise of spring level I hope, Sir, with your kind permission to discuss later, but now I am dealing with malaria.

How many tea and coffee planters who manage estates at the feet of hills, could lead turbid water from streams and hill watercourses through their plantations and help to keep down malaria! It is the utilisation of this early flood water in watercourses, rills, streams big and small, and rivers big and small, which will one day be the double edged sword to combat malaria and poverty of soil. What India wants to-day are thousands of projects of this kind over the length and breadth of the land. Such projects will bestow the blessings of delta irrigation to every tract they cover. They will lay the foundation and leguminous fodders will be the apex of the structure which will convey health and prosperity to millions of Indian homes.

W. WILLCOCKS.

Cairo, 22nd April 1928.

INDUS FLOODS AND SUKKUR BARRAGE.

SIR,—An alarming official telegram from Bombay reported that, owing to a rise of the Indus water level, one of the coffer-dams of the right flank of the Sukkur Barrage was breached on the 23rd April, the estimated damage being about Rs. 3 lakhs. The Chief Engineer was soon on the spot and found that the damage to the masonry was absolutely *nil*, the damage to machinery from immersion about Rs. 5,000 and the delay to work would be only a fortnight. It has been repeatedly predicted that such accidents are to be expected. This probably accounts for a certain amount of nervousness among the opponents of the barrage, and gives rise to exaggerated rumours with slight provocation in connection with a work that is being constructed at enormous expense, especially as they have been told a weir is by no means essential for the working of the "greatest irrigation scheme in the whole world." Some Punjab Irrigation engineers, who have studied the project, have explained that the Sukkur barrage is not really needed, except for one of the 7 canals of the scheme—the one that is taking up high land on the West; while Mr. F. W. Woods has suggested locating the proposed barrage somewhere near Kashmor (80 miles above Sukkur) if one must be built at all, thus obtaining command of high lands above Sukkur. This would provide the required monument to the skill of the Sind engineers, would have the merit of being useful as well as ornamental and would greatly improve the project by taking in, for perennial irrigation, a large tract of high land on the West, above Sukkur. It would also afford weir control of river supplies of existing inundation canals on both banks for a reach of 80 miles more of Sind, that will not be touched from Sukkur site. The expert weir-builders of the Punjab would gladly have relieved Bombay of the trouble of constructing the said weir, for it would have been located right on the boundary of Bahawalpur State, where they are already working with a staff of highly skilled and experienced engineers, who are now becoming available from the Sutlej Valley weirs work with a lot of special weir-building plant to spare. Perhaps, however, it is not easy for Bombay to surrender the glory and honour that may be expected. So the thing must be located at Sukkur anyhow and at any cost to start with. Later on it may be necessary to build another weir near Kashmor, or to accept the offer of the Bahawalpur Durbar, once rejected, to permit the construction of a canal for that part of Sind from their Panjnad weir, leaving the Indus supplies entirely for the areas below Sukkur and Kotri. The coming hot weather floods will test the Sukkur barrage works more severely than did the April freshet.

H_2O.

Foreign Notes.

Coal Liquefaction in Germany.—A plant is to be completed by next October at the former electrode factory of the A.-G. für Teerverwertung at Duisburg-Meiderich, which is to serve to test the possibility of the liquefaction of Ruhr coal and also to examine the economy of this process. The plant will mean an expenditure of six to seven million marks with a yearly output of 30,000 tons. The gas required for the process of conversion will be supplied by the cokeries of the Concordia pit at Oberhausen by means of a special long-distance gas line. The construction of further coal liquefaction plants will depend upon the result of the testing process at Duisburg-Meiderich.

A Movable Platform Extension.—A rather novel scheme for extending the platform accommodation for trains has just been put into operation at the Wood Green Station of the Central London Railway. There is at the entrance end of the station a turn-out with a sharp curvature which prevented the extension of the platform for the accommodation of longer trains on the main track. The platform has consequently been extended by a wooden structure which can be revolved about a pivot near the tangent point of the turn-out, and is supported by wheels running on sector-shaped rails. This part of the platform can be moved into position to suit either of the running rails by means of a pneumatic cylinder and the operating gear is, of course, interconnected with the signals, so that a train coming up the curve cannot run into the protruding end of the movable platform.

Displacing a Bridge.—A vast programme of port extensions is being carried out at Strasburg with the object of enabling that town to compete successfully with Kehl, on the other side of the Rhine, for the water-borne traffic, which, it is expected, will grow considerably in the future when the French programme of inland waterway development is completed. In carrying out those works the road between Strasburg and Kehl had to be reconstructed at a distance of 310 m. from the old route, and the existing bridge over the short arm of the Rhine had to be removed to the new position. The arch of the bridge from which the roadway is suspended is of box girder design, with large sections at the ends and a small section in the centre. The weight of the bridge is 1,050 tons. The operation is the more difficult because the river at this point describes a curve with an inside radius of 100 m. Rail tracks were constructed along the banks on which rested the ends of the bridge. It was moved along successfully by hydraulic jacks to the new position.

High-power Short-wave Valve.—Experiments with a new type of high-power short-wave valve recently developed by engineers of the General Electric Company laboratories at Schenectady, N. Y., have produced results of an unusual and decidedly interesting character. Those in control of the experiments report that meters in adjacent rooms have run wild, that delicate measuring instruments have been twisted or broken, that the new apparatus has emitted a warm glow, subjection to which has been followed by increasing pain in limbs and joints, that rats in a cage placed close to the radiating wire have become excessively animated, and then, if exposed too long, have died, that a new incandescent lamp has been lighted to full brilliancy without wires or socket, that a cold copper bar lying on the floor has blistered the hand of a man picking it up, that a neon tube has suddenly flooded the room with its glow when merely touched, that simple food has been cooked in a glass tube suspended from a receiving aerial, and that many less spectacular effects have been experienced.

The Manchester Ship Canal.—The net income of the Manchester Ship Canal Company, during the year ended 31st December 1927, amounted to £947,057, as compared with £962,841 during 1926. There was a decrease of £15,982 in receipts from tolls, dues, and miscellaneous receipts, and a decline of 434,144 tons in the net weight of sea-borne traffic, as compared with 1926. The latter year, however, was the highest on record, both for the tons of merchandise carried and for receipts, and was abnormally affected by large imports of coal, amounting to 1,221,655 tons, arising out of the coal stoppage. During the year under review, on the other hand, there was an increase of 357,579 tons in exports of coal. Compared with the year 1925, the undertaking shows an increase of 477,231 tons in sea-borne traffic, and £82,693 in receipts. Among other new works under construction, the reinforced concrete wharf, coal handling plant, and ancillary works at Ellesmere Port docks are approaching completion, and additional grain-handling plant is being installed at the grain warehouse. The deepening of the Ship Canal to 30 feet between Eastham, Ellesmere Port, and Stanlow oil dock has been completed. Extended facilities for coastwise traffic have been provided at the Stanlow oil dock.

Air Condensers.—A month or two ago there was held in Algiers a series of conferences lasting a week and devoted mainly to questions affecting the supply of water in areas that are liable to long and continued droughts, and also to methods of obtaining water in tropical and subtropical regions where the only source of supply is from the hot damp atmosphere itself. In many parts of North Africa the losses arising from droughts are incalculable. Any system which will ensure regular supplies of water will therefore not only contribute enormously to the prosperity of North Africa but may possibly give a value of arid wastes elsewhere. The conferences were summarised at a recent meeting of the Société des Ingénieurs Civils when special reference was made to a method of condensing the hot atmosphere, which appears to be based upon ancient ideas and is now giving quite satisfactory results. This is done by allowing the air to pass into a cool chamber, various forms of which are employed. One type has an ogival section and has very thick walls, preferably of a porous material. In the upper half are holes inclining downwards from the outside, while others incline upwards to ensure a circulation. The inner walls of the thick chamber are made with asperities to facilitate the formation of drops of water as the hot air, entering by the holes or canals, condenses on the cool surface. The water collects in a tank at the bottom underground. It is stated that the chamber will condense two or three litres of water per square metre of surface in a few hours.

Hydro-electric Power Plant in British Columbia.—Very shortly, one of the most notable hydro-electric power plants on the North American Continent will be brought into operation in British Columbia. This is the Alouette plant of the B. C. Electric Railway Company, which will add 12,500 horse-power to the power system at a cost of 2,500,000 dollars. It will be unique in that no operator will be needed, the single generator being controlled from the Stave Falls Power House 11½ miles away. The new plant is the second largest automatic power installation on the continent, being exceeded in size only by one station in the State of Washington, U. S. A. Another unique feature is that water, which would ordinarily find its way down the Alouette River to the Fraser River, is being diverted through a tunnel driven 3,400 feet under the mountain range, into Stave Lake. In this way the water will be used for power development at the Alouette plant, again at the Stave Falls plant, and later it will be used a third time, when the B. C. Electric's plant at the first canyon of Stave River is built. The Alouette plant built at the mouth of the tunnel will utilise the head created by the difference in level of 140 feet between Alouette and Stave Lakes. The storage capacity of Alouette Lake has been increased by a dam raising the Lake level 45 feet.

Motor Coaches in the Italian Alps.—Arrangements were completed, at a conference, held recently at Cortino d'Ampezzo, for a considerably extended service of motor coaches next summer in the Italian Alps, with extensions into Switzerland and France. There is hardly a road in the Alps which is not now covered by motor coach services, some of these vehicles crossing at altitudes of more than 9,000 feet. Under the recent agreement, the coach services will not stop at the frontier line, but will be continued into the adjoining country, thus giving an opportunity for international travel hitherto unknown. Among these important services is one from July to September around Mont Blanc, from Chamonix over the Grand and the Petit St. Bernard to Courmayeur, and *vice versa*. There will be two services, one by a French and the other by an Italian company, using 11-passenger Fiat and Spa coaches. Another international service is one from Turin in Italy over the Alps to Briançon in France, thus uniting two towns which are only indirectly connected by rail. The height of the pass on this route is 6,669 feet. Spa 20-passenger coaches are used for this run. There is another direct daily service from Turin to Nice, *viâ* the Col de Tende, at an altitude of 3,248 feet. Mont Cenis, 6,836 feet above sea level, can be reached daily by Spa motor coaches starting from Turin, and from the top of the pass French coaches carry travellers to Modane and Chambéry.

A New Monitor Ship.—The new monitor ship "Rio Diamante," which was recently launched from the Central Shipyard of William Gray and Co., Ltd., of West Hartlepool, is of interest, not alone on account of her special design of hull, but also because she will be propelled by very efficient quadruple screw steam machinery, says the "Engineer." She is the thirteenth vessel of the corrugated type to be launched, and the fifth in the cargo fleet of her owners, the Thompson Steam Shipping Company, Ltd., of London. Speaking at the launching ceremony, Mr. M. Huntley said that the four sister ships had since 1921 used 10,000 tons less bunker coal than ordinary type ships, and they had therefore been able to carry a corresponding amount of extra cargo. The saving on the coal and the extra freight earned represented a sum of £25,000. In addition each ship through being corrugated could carry 200 tons extra of deadweight, which meant a further increase in the joint earning capacity of £25,000, making in all a total of £50,000. The new ship has a length of 400 feet with a beam of 53 feet and a depth of 28 feet and is constructed to the design of the Monitor Shipping Corporation of Newcastle-upon-Tyne. The hull has 17-inch framing with a double bottom built on the cellular system, with fore and after peak tanks. Special provision has been made for the carrying of grain cargoes. The propelling machinery will be of the balanced quadruple expansion inverted direct-acting surface-condensing type, and steam will be raised in three 260 lb. coal-fired boilers. The superheaters will be designed to give a total steam temperature of 560 degree Fah., and a heater will deliver air to the furnaces at a temperature of about 300 degree Fah. Both the main engines and auxiliaries will be constructed at the Central Marine Engineering Works. Exceptionally economical results are expected.

Dry Cell Materials.—In an article on "Chemical Raw Materials for the Dry-cell Industry," by A. D. Camp, published in "Chemical and Metallurgical Engineering," some interesting particulars are given concerning the ingredients of dry cells. Because manganese dioxide is a natural material purified only by mechanical processes, it is subject to wide variations of purity, depending on its source and treatment. The principal types all differ with regard to their chemical composition, physical condition, and depolarising power, and they often differ from lot to lot. A Philipsburg manganese with a 70 per cent. manganese-dioxide content is a better depolariser than Caucasian ore containing 86 per cent. of the oxide. Outside the depolarising power the fitness of a given ore for battery use is dependent upon the quality and kind of impurities present. Metallic iron accidentally mixed in the ore is very deleterious, and usually all shipments are passed over magnetic separators to ensure its removal. Other metallic elements, particularly copper, lead and silver in any soluble form, are active poisons in a dry cell, as they plate out on the zinc electrode and run the cell down by local short circuiting; their presence should be restricted therefore to mere traces. It has been the author's experience that the cheapest grades of artificial graphite are superior to any other variety, no matter how expensive. Commercial sal-ammoniac should contain less than 1 per cent. of ash or non-volatile residue, and under 0·75 per cent. of moisture. The best material is of domestic manufacture, but the imported, largely from Germany, is considerably cheaper, and is usually satisfactory. Fused and granular zinc-chloride are of about equal purity, but the latter kind is slightly dearer. Small amounts of mercuric chloride are dissolved in the electrolyte for the purpose of slightly amalgamating the inside surface of the zinc can, in order to minimise the effect of any harmful metallic impurities in the mix and to give a slightly higher voltage. It has been found that a blended wheat flour similar to the household brands makes the best dry-cell electrolytic paste.

General Articles.

MODERN FLEXIBLE PIPE JOINTS.

AN INTERESTING PICCADILLY CIRCUS TUBE STATION, LONDON.

FURTHER with regard to the "Victaulic" flexible pipe joint, already described in these columns, another characteristic example of its value is represented by the new Tube Station beneath Piccadilly Circus, London, which it may be stated will be the largest in the world, in the form of a huge circular underground hall, complete with shops, and supplied by eleven separate escalators.

The extensive excavations have necessitated the removal of a complete network of gas and water pipes and electric mains, to say nothing of the famous "Eros" statue, and in connection with water supply there is now used 24″ diameter diversion steel mains which are placed almost in the form of a square round the new station, in a special large tunnel. This 24″ main has also a large number of 18″ branch mains going to all the various streets round Piccadilly Circus, and the test pressure of the entire installation was 250 lb. per square inch, the normal working pressure being approximately 100 lb., although naturally this varies according to the demands for water.

This special diversion tunnel, of which we are able to reproduce photographs, also takes all the other pipes and cables, is actually larger than the Railway tube tunnels themselves, being more than 12′ diameter, and is a magnificent piece of work, while once and for all it will stop the continual digging up of the streets in this area which has been one of London's troubles for years past.

This 24″ water main is fitted throughout with "Victaulic" joints, which it will be remembered have the great advantage of being fitted almost in a few minutes, and also of giving an absolutely dead-tight joint under all conditions, operating almost from complete vacuum to 4,000 lb. per square inch. Further they possess the remarkable faculty of being flexible in the sense that there is no need whatever for dead straight alignment of the pipe line, as well illustrated in the photographs on the opposite page.

The general principle it will be remembered is that the pipes are made with a straight lip or rim at each end, and round this there is fixed a heavy rubber composition ring bent almost double, having round the outside a steel housing ring bolted on. The higher the pressure the tighter becomes the joint, while the resistance of this ring is so great that it is superior to the steel pipe itself. Thus for example many experiments have been carried out by actually bursting lengths of pipe under enormous hydraulic pressure, when the rings are not affected, and it is also an unquestionable fact that the life of the ring will be as long as the steel pipes, as shown for example by the ordinary common flanged joints with rubber rings on gas pipes that have been taken up after 50 years, when they are still as good as ever, although not protected in any way from the soil by the housing ring as in the case of the "Victaulic" joint. The invention also is applicable to practically any gas or liquid other than steam, and is being used for water, many solutions including sea-water and sewage, crude oil, petrol, benzole, natural gas, town gas and compressed air, to mention a few examples, and while the "Victaulic" Company, Ltd. (Dean Stanley Street, Mill Bank, Westminster, S. W. 1.), have just recently issued a new and enlarged catalogue which contains much interesting information on the whole subject of pipe joints.

THE UNIVERSAL P. K. FORMULA.

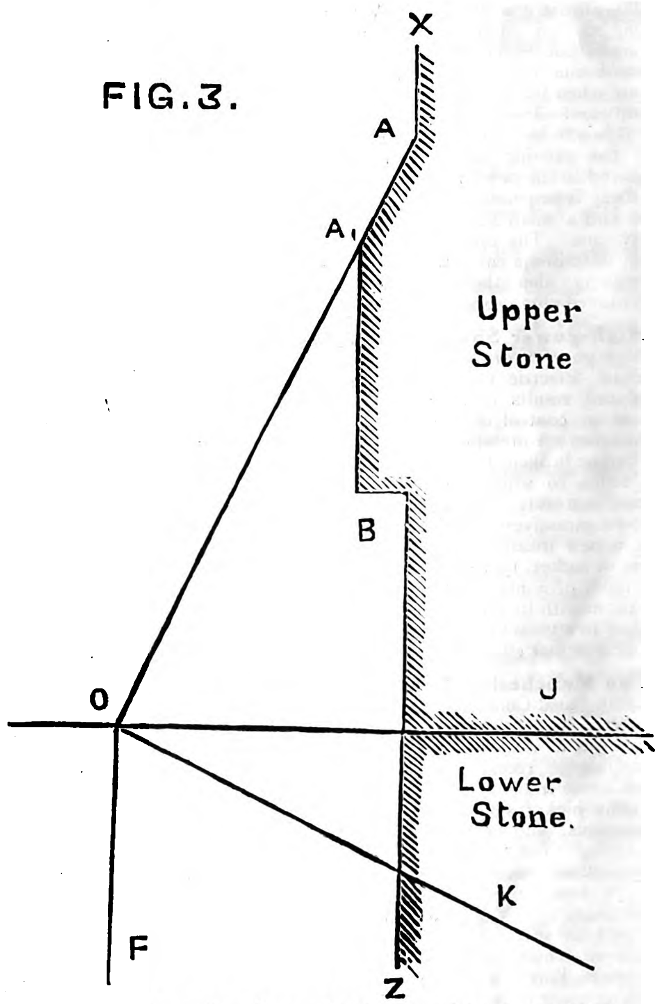
APPENDIX.

(COPYRIGHT.)

IT is desirable that any mathematical demonstration should be made independently, and without communicating with the writer. The following statement of the example in the Great Pyramid, and of the conditions, may therefore be useful.

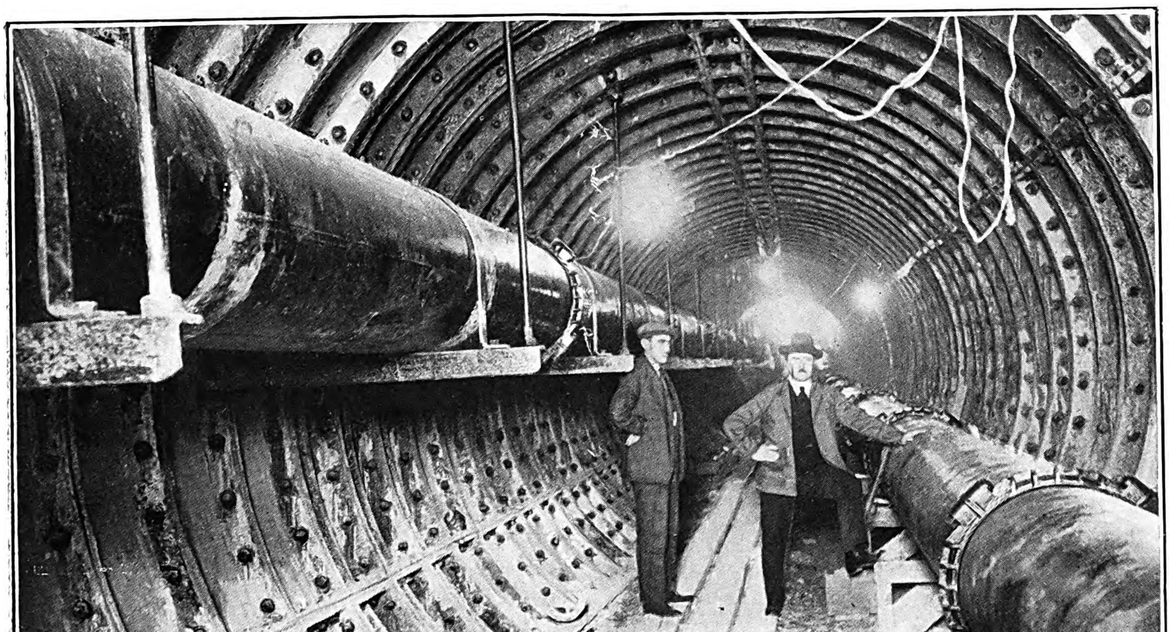
Both parabolas shown in the Granite Boss have their "bases" in a common horizontal plane. The one parabola is 7 inches base-width and is 7 inches in height; the other is 5″ × 5″. (See description and drawings in previous articles.) Assuming the line joining the two vertices is the slant of a cone (the distance between the planes of the parabolas being one inch), the figure below shows the angles, and the peculiarity of the example, which obviously are connected with the other measurements of the Ante-Chamber, and other angles in the Pyramid. The base line of the parabolas is raised 5 inches above the plane of the joint between the two stones which form the Granite Leaf.

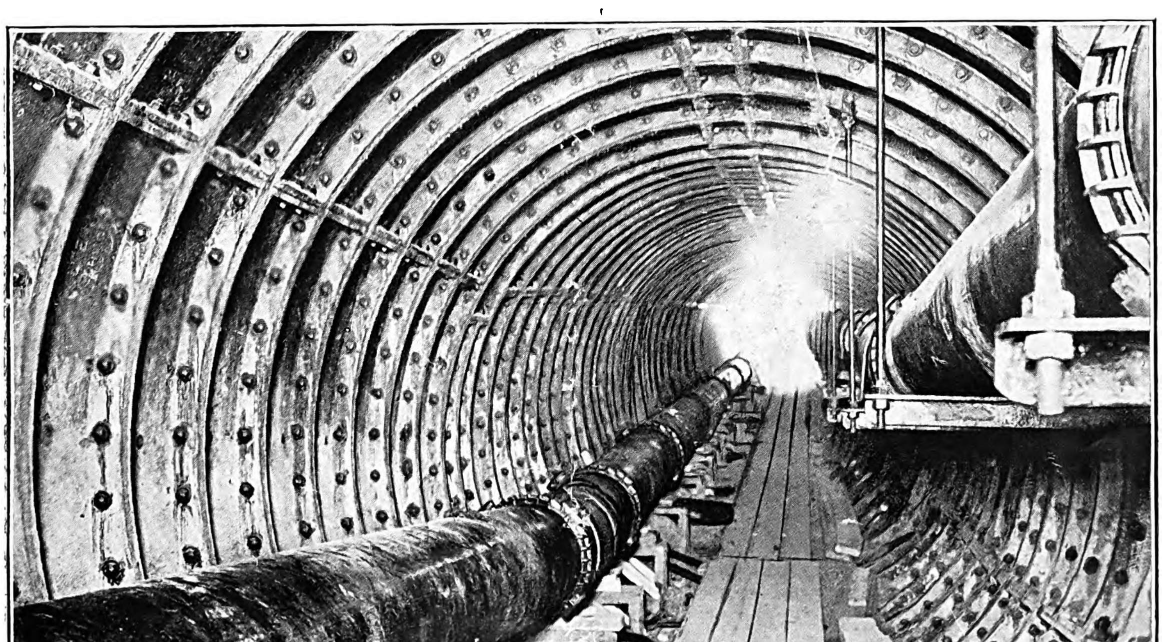
FIG. 3.



Let XZ be the face of the granite leaf, OJ being the plane of the joint; AA_1B the granite boss in section through the vertical centre axis. Let AA_1 produced meet OJ in O, the vertex of the cone of which the two slants are OA and OF. Then tan AOJ = 2, that is 63°—26′—6″ nearly. Draw OK at right angles to OA, and the angle JOK is 26°—33′—54″; nearly the passage angle of the Pyramid; and *perhaps* it is intended to be so, the 5 and the 7 of the parabolas being approximations, by reason of defective skill in the labour? The passage angle is about 26°—26′—30″. [But the demonstrator should not be too sure of this, because the difference of about 7′—30″ occurs elsewhere and unmistakably.]

At any rate, there are two cones, the one JOK, with vertex angle 26°—33′—54″, the other AOF, with vertex angle 153°—26′—6″. The point therefore is this: Do the two parabolas close on the plane OJ or on the plane OK? For it is obvious they cannot stop on the plane B.





MODERN FLEXIBLE PIPE JOINTS.

The data for the demonstration is : Take f instead of m, from zero to 3·000. Since $V = C\sqrt{m}$ then $V_p = C\sqrt{f}$; and C is of any reasonable quantity from zero upwards. As regards the choice between the two planes OJ and OK, the demonstrator perhaps should select that which will bring all intermediate cones with vertex angles betwen the two limiting angles above stated ; a choice, indeed, *to give the easiest possible solution ;* and the most easily calculated equations, in any case. The demonstrator may be certain of this : an obviously tedious and difficult solution is incorrect, and should be abandoned early.*

Σ. Φ.

28th March 1928.

* Though sometimes the writer has found the long way round the simplest, and by factorization, eventually the shortest, in calculation.

TUBE WELLS.

BY H. B. SAXBY, M. I. E. (INDIA), AND A. S. KNOX, A. M. I. E. (INDIA), M. INST. C. E.

THE term tube well has, as far as we can ascertain, originated in India, and in other parts of the world the term artesian or bore hole is usually applied. There is, as far as the writers are aware, no material difference.

The term artesian is generally applied to water which rises above ground level. Nearly all tube wells have a semi-artesian effect particularly in Bengal in that the water often rises to a distance below ground level less than the water found in surface wells.

2. Tube wells in their present form were introduced into India by Mr. John Ashford, M. I. Mech. E., Superintendent of the Central Workshops, Amritsar, some 17 years ago. Mr. Ashford had a double object in sinking the tubes (1) to reduce the subsoil water level in the land near Amritsar which had become waterlogged owing to excessive seepage from the Upper Bari Doab Canal ; (2) to utilise this water for irrigating land which was not commanded by the canal.

From these early experiments tube wells have developed as agents for the supply of pure water all over the alluvial plains of India.

3. Tube wells are only successful where the geological formation is suitable. Such formations are found in the alluvial plains of (1) The Indus Valley (2) The Ganges Valley and (3) The Brahmaputra Valley. In nearly all parts of the alluvial soil deposited by these three great rivers it is possible to obtain pure water suitable for irrigation and safe for domestic purpose.

4. Most of the large rivers of India carry considerable quantities of sand and silt in suspension during floods. This is formed by the weathering of the hills due to frost, sub aerial action, the cutting action of water and the grinding of the boulders washed down in the spates of streams emerging from the hills.

Near the hills the bed slopes are steep and the velocities are high, therefore boulders, gravel and very coarse sand are found near the foot of the hills. Further away the finer sands are found and a larger proportion of clay. Succeeding floods carry the earlier deposits forward but the heavier and coarser materials tend to lag behind.

Backwaters formed by temporary bars in a river encourage the deposition of fine silt which, under compression, forms clay. Rivers tend to raise their beds and to wander in serpentine curves backwards and forwards over their valleys turning back again when an obstacle is met too hard to be scoured. Thus alternate beds of sand and clay are deposited varying in thickness according to the conditions met.

It might be supposed that the beds of sand and clay always lie horizontally. This is not so and often they assume a wavy formation. This is possibly due to wind action which blows the sand up in the form of dunes before the deposition of further layers of clay. Alternatively it may be due to the scouring out of previous deposits by streams subsequent to the deposition of the sands in horizontal layers. A recent example of this took place with the river Teesta near Barnes Junction.

5. The depths and thickness of the different stratas found in boring often show a great variation even when separated by only a few feet. It will be possible to understand why this is so if we consider the river Hooghly and its changing channels. To-day there is a channel 50 feet deep which in a few months will be replaced by a sand bank while the deep channel will have moved across to another part of the bed.

6. Not only do the relative depths and thicknesses of clay and sand in borings in close proximity vary near Calcutta, but there is also a variation in the nature of the soils. In the majority of the tube wells sunk a dark blue clay is found overlying a yellow clay. In some borings, moreover, we find a blue or a white sand, in others a yellow sand and the latter is often overlaid by a dark argillaceous sand full of mica.

It would appear that parts of Bengal formed the battleground of three rivers, *viz.*, the Ganges, Damodar and Brahmaputra, depositing different kinds of material according to the strata found at their sources.

The Ganges alluvium contains, so far as we have been able to ascertain, no blue clay, the clay being yellow and whitish. The Brahmaputra clays are of dark blue colour while the clays transported by the Damodar are yellow and of a more pronounced colour than those of the Ganges.

7. It is not unusual to find rotten wood, leaves and other decaying vegetation in the borings at depths as widely different as 50 feet and 450 feet, evidence of forests and a lower ground surface at a recent geological age.

8. The depth of the Gangetic alluvium has never been ascertained, two notable bore holes were put down at Lucknow and Calcutta between 1835 and 1860 and are described by Oldham in his standard work of the geology of India. The boring at Lucknow was 1,336 feet deep and there was no indication that the bottom of the alluvium was near.

The Fort William bore hole was taken to a depth of 481 feet and Oldham states that it is noteworthy that no trace of marine deposits was detected, but on the contrary there appears every reason for believing that the beds traversed from top to bottom of the bore hole, had been deposited either by fresh water or in the neighbourhood of an estuary.

9. It is a peculiar fact that waters obtained from tube wells may vary very considerably in two tubes sunk to the same depth only a few hundred feet apart. Not only is this the case laterally but also in the water drawn from successive layers of sand separated by bands of clay.

Particularly is this the case in the areas south of Calcutta where the underground water table often contains salt. In some cases the deeper layers of sand have a higher salt content and in others the shallower sands are the more salty. In this area too the water is often very hard.

Within 30 miles of Calcutta we have encountered waters with as much as 500 parts of salt per 100,000 and as low as 2·9 parts. In the Budge-Budge District we have found the salt content as high as 250 parts per 100,000 and again only a few miles from Budge-Budge but actually nearer the sea as low as 8 parts.

The quality of water found naturally depends, particularly in hardness, salinity and iron content, on the alluvial deposit through which it has passed. It is difficult to account for the variation in adjacent borings but

we believe that the reason for the excess of mineral salts is due to the falling off of the gradient of the subsoil water as it approaches the sea. In most areas there is a slope on the underground water table and the water is constantly moving. This was proved by Mr. G. C. Scott who sank three bore holes 250 feet apart in the direction of flow towards the sea. Colouring matter was introduced into No. 1 bore furthest from the sea, No. 2 was pumped and the colouring matter appeared. Colouring matter was introduced into No. 3 nearest the sea and when No. 2 was pumped no trace of colouring matter was found. Colouring matter was then introduced into No. 2 and when No. 3 was pumped the colouring matter again appeared.

We do not believe that the velocity of the underground water is uniform even over a limited area and we consider that there are underground streams in which the movement is greater than that in the intervening strips. Water percolating through the soil dissolves mineral salts and unless it is changed by the inflow of fresh water the percentage of dissolved salts tends to increase. The presence of definite underground streams in which the water is constantly changing would account for the variation in the quality of the water found in different borings.

The remedy for getting rid of salt would appear to lie in putting down a bore where there is known to be strong underground flow. It has now been established that certain persons have the power of "divining" or "dowsing" running water and although we have not yet carried our investigations sufficiently far to establish this theory without doubt, we believe it to be the only method of obtaining a "sweet" supply in places where water too high in salt for domestic purposes has hitherto only been obtained.

It is interesting to note that at Puri borings put down in the high ground near the sea give fresh water while those further inland in the low swampy ground on the north side prove salt. This we believe is due to a steeper hydraulic gradient in the former case and the constant replenishment of fresh water from an inland catchment.

10. The underground layers of sand found in the alluvial plains form huge reservoirs of water which fills the interstices of the grains. This water is under pressure and is kept down by an impermeable layer of clay. When the clay is pierced by a boring the water rises in the bore hole. In Calcutta good water bearing strata is found at a depth of 200 to 500 feet below ground level and the water is under sufficient pressure to cause it to rise within 10 to 15 feet from the surface. In Bengal it is rarely more than 18 feet.

In parts of Sylhet artesian action is found and water rises in some of the tube wells above ground level. In the Gangetic plain the water level south of the river is generally found to be much deeper than on the north. In parts of the United Provinces south of the river the water is as deep as 77 feet below ground level, examples being Allahabad 48 feet to 77 feet, Cawnpore 30 feet to 58 feet.

The higher water levels north of the Ganges are probably due to the enormous seepage of water in the porous soil of the Bhaber which lies between the Himalayas and the Terai.

We have recently come across an interesting example of the variation in pressure of the underground strata in a boring in Assam close to the Himalayas. For a depth of 40 feet the water level in the bore was 8 feet below ground, at this depth a bed of clay was pierced and again a bed of sand. In the latter the water level was 30 feet below ground level.

11. Tube wells are sunk as follows. First a steel boring pipe is sunk through the clays and sands until sufficient good water bearing sand is pierced. In this pipe a strainer with very fine openings is lowered and continued by means of a plain tube up to ground level. The boring or casing pipe is then withdrawn leaving the tube well ready for attaching the pump. The purpose of the strainer is to hold back the sand while permitting the water to be drawn off.

There are many different types of strainers. They are chiefly of American make or copies from American designs of strainers for oil wells. Unfortunately few are suitable for the purpose and those that are, are expensive. A considerable number of tube wells go out of action every year owing to the flimsy and unlasting nature of the strainer used. Bengal is littered with defunct tube wells, as apart from the quality of the strainer used, most of the small tube wells are shallow, the depth being limited by the type of plant used for sinking. The shallow sand beds must necessarily be fine in nature owing to the limited bed slopes of the rivers by which they were deposited. It is only that the deeper levels in areas remote from the hills that suitable sands are found for the installation of tube wells of a lasting nature.

12. Tube wells are being used very widely for irrigation and for the provision of drinking water. For the former tube wells giving a large yield are only, as a rule, economically sound, and it is usually advisable to aim at a yield of from 1 to 2 cusecs. A tube well of this capacity will irrigate an area of from 100 to 250 acres depending on the type of crop grown.

For the provision of pure drinking water the tube well is unrivalled in capital and running cost. Not only is the expense of filtration avoided but also zone distribution can be adopted effecting a great saving in friction losses and in the size of distributing pipes.

For individual houses, tea gardens, railway water supplies, coolies lines, construction camps, etc., the tube well often offers a solution difficult to solve otherwise.

13. It is here necessary to say a few words in connection with the type of pump that is most suited for a tube well. The tube well is really a sieve (the strainer) lowered into the sand. Sand when placed on a sieve with a mesh sufficiently large to pass 50 per cent. through, tends to "bridge" and will not fall through unless the sieve is agitated. The type of pump should therefore be one that will work without setting up vibration or pulsations. A centrifugal fulfils these conditions and is in our opinion the type that is most suitable. The three throw ram pump gives a very steady draw and is suitable and reliable for yields up to 100 gallons per minute. Beyond this quantity of water the pumps are large and tend to become expensive. The pump should in every case be regulated in such a way that it cannot be speeded up to take more from a tube than the tube is designed to yield. In calculating the suction lift an allowance must be made for the "depression" or infiltration head. This varies from 6-15 feet according to the amount of water withdrawn from the tube.

In cases where the rest water level is from 16-20 feet below the pump the addition of this infiltration head gives too high a suction lift for an ordinary pump. It is then necessary to employ either a borehole, deepwell or air lift pump.

The borehole pump is probably the most efficient, its disadvantage is that from time to time repairs and adjustments are necessary which entails withdrawing the pump from the tube and stopping the supply in consequence. The adjustments necessary are fine and outside the knowledge of the ordinary Indian Mistry.

The same remarks apply to a deepwell plunger pump or pump driven by rods inside the tube. The amount of water that can be taken out of a tube by this type of pump is limited and is probably in the neighbourhood of 20 per cent. the normal yield.

The air lift pump has much to commend it the only disadvantage being its inefficiency. The advantage is that more water can be got out of a tube well than by any other method, and all working parts are above ground and repairs to the air compressor can be effected without closing the supply for any length of time. Where large quantities of water are required to be pumped to a considerable height or distance it

is advisable to raise the water to ground level only by air lift and then to use an efficient turbine or other type of pump. A group of tubes can be discharged by one compressor into a central sump and by one pump from the sump to a high level water tower.

In our opinion the great future of tube wells lies in Agriculture, for irrigating such land that is not periodically flooded and for growing crops in the cold weather season. Much has been done in this direction in the Punjab and U. P. Bengal has hitherto been considered sufficiently well watered not to need cold weather irrigation, but we believe Bengal to be suited for irrigation more than the forenamed provinces on account of the spring level of water being closer to the ground than in most parts of Upper India. Irrigation is very much a matter of cost and every foot saved in lifting the water tends towards cheaper water on the land and we believe that once this is realised by the Zemindars it will be possible to grow two and possibly three crops on land which now only produce one. There is sufficient in this question alone for a paper on the subject, but as this is a question of Agricultural Economics rather than the engineering side of tube wells we therefore refrain from more than a passing reference to it.

INTERNATIONAL ELECTROTECHNICAL COMMISSION.

CO-ORDINATION OF THE INTERNATIONAL TECHNICAL MEETINGS.

INTERNATIONAL Congresses and Meetings to discuss technical subjects are on the increase and so also are the possibilities of overlapping of effort. Whilst these facts are quite well recognised, until recently apparently no concerted action has been taken to attempt to minimise if not to prevent this state of affairs.

On the occasion, however, of the meeting in Italy in September 1927 of the International Electrotechnical Commission, the opportunity was taken to convene an unofficial meeting of representatives of several international organisations which happened to be holding meetings in Italy about that time.

Signor Guido Semenza, the then President of the I. E. C., was in the chair and seven international technical organisations were represented.

The idea of contact with each other through some central committee was well received, and the I. E. C. which had initiated the movement was invited to act as convener for such an unofficial committee.

In January of this year a first meeting of the unofficial "Comite d'Entente," as it was suggested it should be called, was held in London at the offices of the I. E. C., when representatives were present from the International Illumination Commission, World Power Conference, International Consultative Committee on Long Distance Telephony, International Union of Producers and Distributors of Electrical Energy, International Standards Association (in process of formation), and International Electrotechnical Commission.

Professor Clarence Foldmann, the new President of the I. E. C., was in the chair and an interesting exchange of information took place regarding dates of future meetings and in one or two cases of the preliminary programmes. It was felt that if information of such a character regarding dates and programmes could be exchanged at infrequent intervals, say once annually, it would be bound gradually to lead to most helpful co-operation and be of advantage to the delegates attending the many international meetings as well as probably enhance the value and usefulness of the meetings themselves.

The question of the co-operation between international organisations by joint international committees as well as by observers was also touched upon. Finally it was decided to keep the unofficial committee in being with the I. E. C. as convener and to call another meeting a year hence by which time the various organisations represented would have had time to give their official decision, which in most cases it is anticipated will be favourable, regarding the permanent establishment of such a committee. It is also hoped that other international organisations in the technical field will be interested in this co-operative idea which, while leaving each organisation entirely free, yet provides a kind of clearing house through which information may be exchanged and administrative matters discussed in a free and friendly manner.

HANDYMEN OF THE HIGHWAY.

WITH its network of A.A. road patrols and roadside telephone boxes, stretching from the south coast of England to far north in Scotland, Britain has—through the Automobile Association—a road intelligence service which is not to be found in any other part of the world.

Throughout the blizzards, thaws, floods, frost and fog at Christmas this road service did invaluable national work. Day and night the London headquarters of the Automobile Association were linked up with all its Area Headquarters in various parts of the country. They, in turn, were in touch with their road patrols, so that from London it was possible to have all available information of the latest road conditions from Penzance to Aberdeen. This was circulated to the Press, and broadcast.

Out on the road the patrols were warning traffic of the dangerous or impassable places, working out alternative routes, where feasible, and giving aid to stranded vehicles. As there was an unusually large amount of traffic on the roads during and after the Christmas holidays, the danger, confusion, and delay would have been very much greater for travellers but for the assistance of the A.A.

Many strange and not a few humorous experiences are recorded by the patrols. A Kentish farmer visiting his barn after the storm was amazed to find two motor cars there, one a superb saloon and the other a small car. He may be pardoned if he rubbed his eyes for a few moments, and had happy visions of a belated Christmas present from some munificent friend, or he may have even thought that the Government had at last decided to do something handsome for the poor farmer. But the vision was shattered when on proceeding to another outbuilding he found two more cars. It was beyond the limit of a friendly act to load him up with four cars!

Meantime, A.A. Headquarters were being called up by motorists who had left their cars in farm sheds "somewhere in Kent." Finding the right cars was no easy task, for more than fifty motors were discovered in various sheds and barns. They had been run in during the blizzard, their owners hurrying away on foot for the nearest village through fear of being snowed up on the road.

More than a hundred cars were found embedded in deep drifts on one of the main roads between London and the coast. Despite warnings, many drivers persisted in going on, only to add to the number already imprisoned in the snow. Small cars wholly disappeared in some of the drifts, and it was rather amusing on the following day to see people probing the depths of snow with sticks in the endeavour to find their car. One motorist chartered a team of men to dig for his car, and after much toil an explorer called out that he had struck it with his shovel. Further digging brought a milestone to light!

A farmer in the west country made money out of the snow by charging half a crown toll for each car which drove across his field in order to make a detour around an impassable drift in the roadway.

Two motorists set out from London on Christmas Eve for a journey through Wales. Their friends

became anxious when no news arrived after several days. The only information given to the A.A. was the name of the car owner. As he was a member his badge number and his car number were found for identification purposes, and the patrols were notified. Eventually in a remote part of Wales the travellers were found stranded by a patrol. After losing their way many times in the storms they were held up by tyre troubles.

An overturned and abandoned car was discovered by a patrol on the Great North road after the blizzard had abated. The only clue was its A.A. badge. The matter was reported to headquarters, the registered owner was found, and communicated with. This was the first news he had obtained of his car, which had been stolen in London on Christmas Eve! The thief had run into a drift, and probably had to walk back to London.

Red flags by day, and lights by night, were used to mark many dangerous drifts and floods. Fallen telegraph and telephone wires lay across the roads in places and formed a danger to traffic. They were moved back, and trees and other obstructions were cleared by the aid of the patrols.

BALL BEARING.

THE Ball Bearing has now established its position as an eliminator of frictional losses in Machinery, and as a corollary, it has also played an important part in making possible mechanical performances which would have at one time appeared impossible, but which are to-day commonplace.

One of the spectacular events of the recent past, is the flight of the Junkers-made aeroplane "Bremen" from Baldonnel to Greenly Island off the mainland of the United States. The item of frictional losses and the additional weight of lubricants, etc., would have rendered a run of 3,200 miles at a single run with the engine going "full out" the whole while, impossible, but to-day with the help of the D. W. F. Ball Bearing used by the Junkers Company, it is an accomplished fact, and likely in the near future to become an event of ordinary occurrence.

The air has provided more than one occasion for the Ball Bearing, to give a spectacular account of itself, for the "ZR3" like the "Bremen" was fitted with D. W. F. Ball Bearings, and it was on these bearings that she put up her 5,000-mile flight from Cologne to New Jersey. The same craft has, since then, made another notable flight from Lakehurst (New Jersey) to Panama, a distance of 2,265 miles, in weather which riveted public attention on the conquest of mechanical power over adverse meteorological conditions.

On land too, D. W. F. have spectacular victories standing to their credit, as for instance, in the Alfa-Roneo car which took first place in the Grand Prix Race of Italy in 1924, and again in the Grand Prix Race of Lyons in the same year. On the road, 1924 was a good year for D. W. F. for again in the 24 hours' International Race near Milan, the N. A. G. car came to the front, putting up an average speed of 110 kilometers (70 miles) per hour.

The few leading makes of Ball Bearings like the D. W. F. have all got their tale of success under strenuous and exhaustive tests, and it is these which have brought them into the foreground and placed them in a different category from the multitudinous makes which have now come to jostle each other in the market. When considering Ball Bearings it is a moot point whether any but proved makes are a business proposition. Buyers will probably compare prices in conjunction with performances and it would be interesting to observe the results of the inevitable competition. On the score of quality and reliability, the D. W. F. stands second to none.

The Gazettes.

Bihar and Orissa, May 2, 1928.

Public Works Department.

Babu Achyutananda Pujari, Temporary Assistant Engineer, is appointed to the Bihar and Orissa Engineering Service as a Permanent Assistant Engineer, with effect from 1st April 1928.

Mr. Jogananda Bakshi, Assistant Executive Engineer, is transferred from the Chota Nagpur Circle to the South Bihar Circle and appointed to officiate as Executive Engineer, University Division.

Mr. S. K. Ray, Executive Engineer, Cuttack Division, is granted leave on average pay for four months, with effect from 8th May 1928, or from any subsequent date on which he is relieved of his duties.

Irrigation Department.

Rai Sahib Upendra Nath Ghosh, Assistant Secretary to the Government of Bihar and Orissa in the Irrigation Department, is granted leave on average pay for two months and a half, with effect from 16th April 1928.

Babu Upendra Nath Mukharjee, Head Assistant, Irrigation Department, is appointed to act as Assistant Secretary to the Government of Bihar and Orissa in the Irrigation Department, with effect from 16th April 1928, *vice* Rai Sahib Upendra Nath Ghosh, on leave.

Mr. Abdul Karim, Executive Engineer, on special duty, is posted to the charge of the Dehri Division. *vice* Mr. C. S. Saunders, Executive Engineer, temporarily transferred to the Public Works Department (Buildings and Roads).

Punjab, May 4, 1928.

Buildings and Roads Branch.

On being relieved of the charge of the Simla Provincial Division, on 30th March 1928, Mr. S. Bashi Ram joined the Ambala Provincial Division on 5th April 1928, and took over charge of the Division on the same date from Mr. L. S. Adlard, Executive Engineer, proceeded on leave.

On relinquishing charge of his duties as Personal Assistant to Chief Engineer in the Punjab Public Works Department Secretariat, Buildings and Roads Branch, on 17th March 1928, Mr. J. H. Johnston, Executive Engineer, joined the Second Lahore Provincial Division on 19th March 1928, and took over charge of the Division on 23rd March 1928, from Rai Sahib Lala Sant Ram, Executive Engineer, transferred.

On transfer from the Second Lahore Provincial Division, which he left on 23rd March 1928, Rai Sahib Lala Sant Ram, Executive Engineer, took over charge of the Second Circle of Superintendence on 28th March 1928, relieving Mr. L. S. Adlard, Executive Engineer, of the additional charge.

Hydro-Electric Branch.

The Punjab Government (Ministry of Agriculture) is pleased to appoint Mr. N. B. Macmillan as a Sales Engineer in the Punjab, Public Works Department, Hydro-Electric Branch, for a period of two years. Mr. Macmillan landed at Bombay on 20th April 1928, reported his arrival at Lahore on 23rd April 1928, and assumed charge of the duties of Sales Engineer in the office of Chief Engineer Hydro-Electric Branch, with effect from the same date.

Lieutenant N. Boddington, R. E., Assistant Executive Engineer, whose services have been placed at the disposal of the Punjab Government, reported his arrival in the "A" (Adit) Division of the Punjab, P. W. D., Hydro-Electric Branch, at Jogindarnagar, on 29th January 1928, and took over charge of "T/S." Subdivision of the "Adit" Division on 16th February 1928, from Mr. A. Farquharson, Tunnel Engineer, transferred.

Major A. Sanderson, D. S. O., M. C., Executive Engineer, "A" (Adit) Division, took over charge of the "T/S." Subdivision of the "A" (Adit) Division, on 12th March 1928, from Lieutenant N. Boddington, R. E., Assistant Executive Engineer, in addition to his own duties.

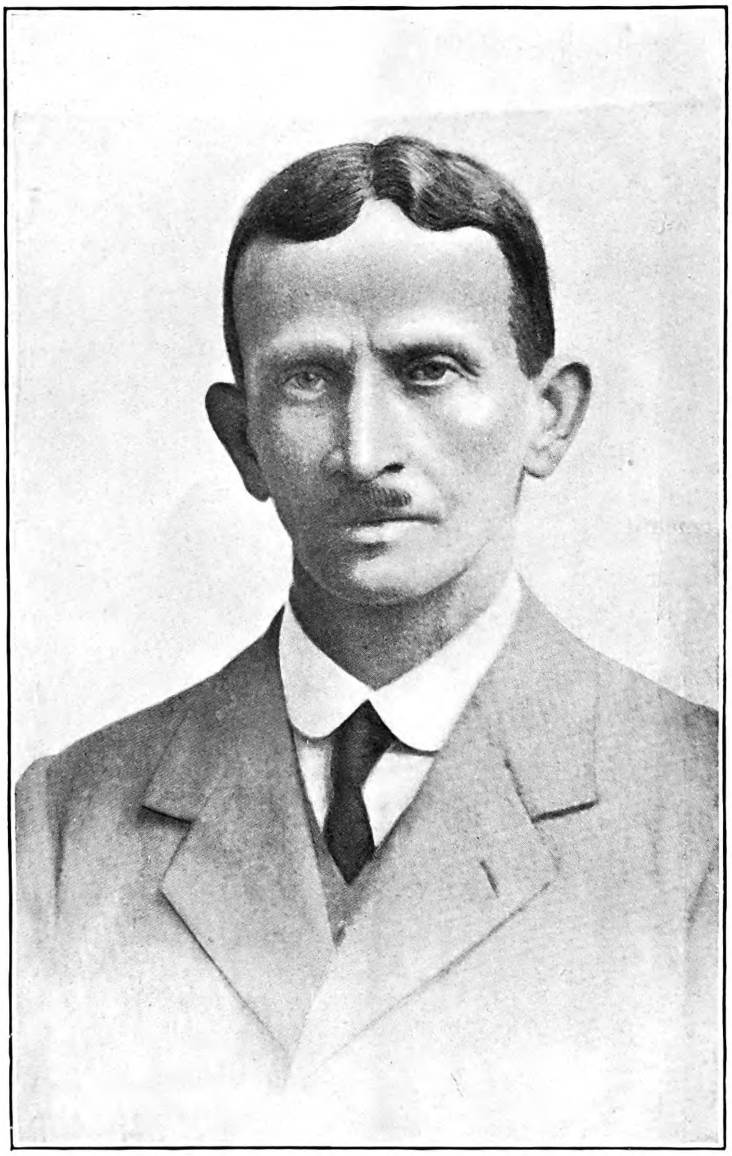
Major A. G. Wheeler, Assistant Executive Engineer. "T.L./N." Subdivision, joined the "P./H." Subdivision of "P" Division on 19th March 1928 and took over charge of the Subdivision, in addition to his own duties, on 29th March 1928, from Mr. E. H. Knight, Assistant Executive Engineer, proceeded on leave.

Mr. A. S. Corrigan, Additional Assistant Secretary to Government, Punjab, Public Works Department, Hydro-Electric Branch, is granted leave on average pay for two months, with effect from 9th May 1928, or subsequent date.

Irrigation Branch.

Mr. J. B. G. Smith, C. I. E., Chief Engineer, on return from leave, landed at Bombay on 27th April 1928, and took over charge of the duties of Chief Engineer and Secretary to Government, Punjab, Public Works Department, Irrigation Branch, Northern Canals, on the 30th idem from Mr. H. F. Ashton, Officiating Chief Engineer.

Mr. E. N. Fenwick, Executive Engineer, attached to the Public Works Department, Punjab, Irrigation Branch, is allowed by the High Commissioner for India leave on medical certificate on half average pay for two months and on quarter average pay for two months, in extension of the leave granted to him previously.



PROFESSOR E. P. STEBBING, M. A., F. L. S., F. Z. S., F. R. G. S.

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INDIAN ENGINEERING.

SATURDAY, MAY 19, 1928.

PROFESSOR E. P. STEBBING, M. A., F. L. S., F. Z. S., F. R. G. S.

A COMBINATION of intellectual and athletic gifts is not, when one comes to think of it, so very rare ; a boy may be a bright scholar without being inept at games, and if he happens to be an athlete he is not necessarily a dullard. There have been many men who have excelled intellectually and in the field of sports ; and Professor Stebbing, late of the Indian Forest Service, who, owing to special qualifications, was one of the earlier Forest officers to be employed on research, who was afterwards a prolific writer, and finally Professor of Forestry at the University of Edinburgh, was not a man given solely to sedentary occupations. He was keen on games, he was fond of hunting, shooting and fishing, and if he was happy in a library, he was also happy travelling in the wilds. "The only happy man," said Professor L. P. Jacks, "is the man who enjoys his daily work, and the only good man is he who does it to the best of his ability ;" and Professor Stebbing was always throwing into his work an intensity of endeavour as if he liked it and meant to do it as well as it could be done.

Edward Percy Stebbing appears to have inherited his abilities from his grandfather, the late Rev. Henry Stebbing, D. D., F. R. S., a man of considerable attainments. Born in 1870, he entered Coopers Hill in 1890, and did well there, winning the prize for entomology. He received his forestry diploma in 1893, and, posted to Bengal, arrived at Calcutta on 1st December of that year. He was first sent as Assistant to the Singbhum Division in Chota Nagpur, a division in which the forests at that time were very little known and untouched. Developments came later, and in the meantime young Stebbing graduated in big-game shooting by bison-tracking on foot, which was considered the cream of the sport in that locality. In 1896, Government contracted to supply three lakhs of sal sleepers for the Rai-Bareilly Railway, and the first extensive fellings commenced. Mr. Stebbing twice officiated for short periods in charge of this division, which has since been divided into three separate charges. He also held charge of the old Tista Division in British Sikkim for a couple of years, and as there was not much work beyond that of meeting the demands of the tea planters at the lower elevations, Mr. Stebbing found time to cross the high mountain ranges into both Bhutan and Tibet. He was next posted to the Chittagong Division, one of the heaviest divisions of Bengal, now three separate divisions, and while in this charge he was employed as assistant to the officer assembling the Indian exhibits for the Paris Exhibition of 1900. In the Chittagong Division he also captained a station football team, playing the surrounding Bengali colleges and schools

and making the matches very popular. They were so popular that he presented a cup for competition between the various teams; and, when he was transferred, so great was the regard for him that he was given a very cordial farewell reception and departed like a Governor with detonators laid on the rails.

The transfer from Chittagong in 1901 was due to Mr. Stebbing's appointment as Forest Entomologist under the Government of India, the first research post that had been created. The post was one to his liking, entomology was a favourite subject of his, he had won the prize for it at Coopers Hill, and among his many publications are "Injurious Insects of Indian Forests," "Departmental Notes on Forest Insects," "Insect Intruders in Indian Homes," and "Indian Forest Insects of Economic Importance." The headquarters of the post were at Dehra Dun, and there Mr. Stebbing also lectured on entomology at the Forest School. Entomological research in India was then an entirely new field of work, but it was recognised that it was a branch of work of importance, and it was merged into the Indian Forest Research Institute when that came into being in 1906. At the time this invaluable institution was established by the orders of Lord Curzon, Mr. Stebbing was the only Forest research officer in existence, and the wonderful outcome of the Viceroy's wise step is now well known in India and elsewhere. In 1903, Mr. Stebbing officiated for about eleven months as Superintendent of the Indian Museum at Calcutta during the absence of the permanent incumbent of the post, Major Alcock, I. M. S., F. R. S.; and his indefatigable energies led him to take part in the Calcutta Rugby Cup matches of September 1903. He played in the Service Fifteen and his team reached the semi-finals, which was not a bad feat for a man who had served ten years in the country. In 1904, whilst on leave and with the permission of the India Office, Mr. Stebbing visited nearly all the Forestry schools in Europe, including Russia, and at the same time many of the Continental forests. On rejoining at Dehra, he undertook the honorary duties of editor of the "Indian Forester" and ran the magazine for five years. In 1907, he became the first editor of the publication of the Forest Research Institute, and framed the lines on which the new publication was issued. Simultaneously, his own investigation work was taking him all over India and Burma, but busy as he was he always seemed to be able to find time to undertake something more. In December 1909, Mr. Stebbing took two years' furlough, and in 1910, when Colonel Fred. Bailey, LL. D., R. E., a former Director of the Forest School at Dehra, who had held the post of lecturer in Forestry at the Edinburgh University for seventeen years, decided to retire, Mr. Stebbing was selected to succeed him. The Secretary of State gave Mr. Stebbing permission to hold the post during his furlough, and at the expiration of his leave he resigned the Forest Service of India. Later, in 1920, when the lectureship was raised to a Chair of Forestry, he was appointed to fill it.

Forestry work at Edinburgh had in fact become important for special reasons. On the abolition of Coopers Hill, Sir William Schlich had moved the College School of Forestry to Oxford and had done splendid work there. But it seems that it was felt to be desirable that there should be more than one University qualified to train forest probationers, and Cambridge and Edinburgh (which at the time was the only University giving a B. Sc. degree in Forestry) came to be recognised. Mr. Stebbing therefore held a responsible position at Edinburgh, and he has trained, subject of course to a practical course on the Continent, especially in France, a large number of students, not only for India but for the whole of the British Empire. So his retirement from the Indian Forest Service meant no respite from work for him. His publications include "Manual of Forest Zoology," "Jungle By-ways in India," "Stalks in the Himalaya," "British Forestry," "Commercial Forestry in Britain," to mention only a few, and then, last but certainly not least, came his monumental work on "The Forests of India" in three large volumes, which will be a valuable work of reference. It meant dipping into the archives of the Hon. East India Company for old facts and an extended tour in India to be in touch with new. In the Great War, he was for a time in Macedonia with the French and Serbians on transport work, he was also on duty in France, and subsequently in Russia up to the date of the Revolution. Always athirst for knowledge, he made during his stay in eastern Europe an adventurous journey up to Archangel and thence to the foot-hills of the Urals. He also visited Finland, Norway and Sweden, and made acquaintance with the gigantic belts of forests in that part of the world, crowding fresh experiences into his days. In India, it was always known that his powers of work were remarkable, and that he must have worked very long hours or with great rapidity. Yet he found time for his recreations. In Singbhum he was a trooper in the Chota Nagpur Mounted Rifles and won several prizes in the annual gymkhanas. In the Tista Division he was a corporal in the Northern Bengal Rifles, and won the competition for the best shot at objects floating down the Tista River. At Chittagong he was a sergeant in the Chittagong Rifles. In 1900 he passed the examinations and was appointed a second-lieutenant in the Cavalry Branch of the Indian Army Reserve of Officers, and was afterwards promoted to Lieutenant, passing the practical tests up to Squadron Commander. He was an enthusiastic big-game shot, and his love for horses led him to polo and pig-sticking. At Chittagong and Dehra he ran the clubs as honorary secretary, always an exasperating duty. At Dehra he also ran the paper-chases for nine years, and in his last year was the honorary secretary of the race meetings. There was something dynamic about him, he saw the world picturesquely, he was never tired, and after his retirement from India, when he was no longer in his first youth, his vigour remained unabated.

It is unabated still, although he is approaching sixty years of age, and it has to be admitted that he is one of those fortunate men who possess the combination of intellectual and athletic gifts, which even if it is not so very rare is denied to the multitude.

ARCHITECTS AND DECORATORS.

THE question of the inter-relationship between architects and decorators in the West has for some time been fairly acute; and it is a matter of congratulation that for the first time in the history of the Royal Institute of British Architects and of the Incorporated Institute of British Decorators there should have been a meeting of the two bodies to discuss the subject, "Are the relations between Architects and Decorators satisfactory?" The question is one which may not at the moment seem to be of any importance in India, but it is going to be, and in the ordinary progress of events it is bound to be. Architecture in India in the hands of qualified, professional architects is a comparatively new thing. The first official architect in India was Mr. John Begg, who was appointed consulting architect to the Government of Bombay in 1901, he was followed by Mr. James Ransome, who was appointed consulting architect to the Government of India in 1903, and subsequently there were other professional men engaged by the various provinces. The move was altogether a good one; architecture had previously been considered a branch of engineering and in the hands of the engineers of the Public Works Department it had never been satisfactory; the engineers were not trained architects and if their work left much to be desired the administration was to be blamed. The qualified architects came, however, in course of time, and in course of time came also a certain number of architects in private practice. The architects in private practice in the country will doubtless continue to increase in number; the tendency of the present is to employ them more to the exclusion of the Buildings Branch of the P. W. D.; and with them, as the standard of living rises, is likely to come the professional decorator.

To the man in the street, the notion too often is that the architect designs and supervises the construction of the shell of a building and with that his connexion with the building ceases. But in that he is mistaken; to take specific instances, the Adam Brothers and Kent, well known architects of the eighteenth century, a century in which architecture was something to talk about, designed buildings and the decorations of them in all details, as well as the furniture and fitments down, as it was said, to the salt-cellars. It was not extraordinary that it should have been so, the architect of reputation, for the sake of his name, is not unnaturally desirous that the building which he has designed should in its interior be in accordance with his aim in all particulars. But though the methods of the Brothers Adam in their completeness do not now obtain, the architect, in designing a building, is certainly concerned in seeing it finished with all its internal mural decorations. It is not to be supposed that the eminent architects of New Delhi, Sir Edwin Lutyens and Sir Herbert Baker, would have been content to design exteriors only and to leave interiors to decorators of whose ideas they might be wholly unable to approve. Granting then that the interior of a building designed by an architect is the architect's affair, we come to the procedure. The craftsmen employed by the architect, whether in externals or internals, are in many practical details of their crafts superior in knowledge to the architect, they have nevertheless to regard him as the conductor of the orchestra directing the various executants in interpreting the work of his own composition. The architect, as conductor, will if he is wise establish a sympathetic understanding between himself and the performers of his band, knowing that the more they work together in amicable accord the better the results, but he remains the boss when it comes to a question of difference of opinion.

Now, of all the executants the decorator is the one who probably gives the architect the most trouble. In the first place, it is not always a matter of decorating a building which the architect has himself designed, regarding which he has his preconceived ideas, he may be called in to decorate a building of long standing designed in the past by someone else; and in the second place, decorators now belong to a highly-skilled profession, they may themselves know a great deal about architecture, they are conversant with correct period styles, they are often and often employed by clients without the intervention of an architect at all, and in their independence of attitude they may resent orders with which they cannot agree. It has doubtless frequently happened that the decorator has just as good taste as the architect, possibly better, and by virtue of his special experience in a special line he may have a surer instinct for effect. In such cases it is all the more galling to him to be told to do this or that when he feels that his own opinion is the better of the two. But that cannot be helped, as long as the client, instead of employing a decorator direct, prefers to have the services of an architect, it is the architect who is responsible and he is right to regard the decorator as his subordinate. These remarks do not by any means imply that there is always difficulty, the architect may himself be a specialist in decoration and employ for his purposes a decorator-contractor of an ordinary kind who will do without question anything he is ordered. The trouble comes when the decorator has a reputation and a client desires that he should be employed. Besides being a mural decorator, he may be skilled in the effect of a complete room, including carpets, furniture and fitments. The moral is, however, that if a client requisitions the services of an architect, it is the architect who must have the final say and that fact should be accepted by the decorator with good feeling; or if the client has faith in the judgment of a specialist decorator,

he should do without an architect and leave the decorator free to carry out his scheme unhindered by control. The recent meeting of British Architects and British Decorators has been very valuable in ventilating the whole question with a view to arriving at a more satisfactory state of affairs and a more friendly spirit of co-operation. The discussion at the meeting was conducted so temperately and courteously by all those who attended it that the prospects of a better understanding are considerably improved.

THE WORLD'S FOOD SUPPLIES.

"HOMO sum; humani nihil a me alienum puto" said Terence, and if nothing that relates to man is foreign to our feelings we cannot fail to be interested in matters concerning the food supplies of the world. The whole of a new book, "The Human Habitat," by Ellsworth Huntington, Research Associate in Geography, Yale University (Chapman and Hall. 15*s.* net), is not devoted to that question, but a part of it is, and it is a part which is exceptionally interesting in the face of all the talk about the prospect of a world's shortage of food owing to the ever-increasing population. In that aspect the outlook is generally directed towards the tropics where there are still large areas of land uncultivated. But if hopes lie there, the author's remarks are disappointing. He is an American, and he writes more particularly from the point of view of the United States, but that does not matter very much as his remarks are of general application. From the tropical regions are obtained three important articles, sugar, coffee and rubber; also, less important, tea and cacao; in addition, there are three fibres, jute, Manilla hemp and sisal; one fruit, the banana; one nut, the coconut; and a group of spices. Of these, temperate-climate countries would find it difficult to do without sugar; and without rubber, unless synthetic rubber comes to be invented. The importation of the rest might come to an end without any serious harm. So that people who look to the vast unused tropical lands for enormous quantities of food, as well as raw materials, for the support of the growing population of the manufacturing countries of Europe and America have not so strong a case as they imagined. The tropical countries do not come very well out of the examination, still they have the valuable cereal, rice, and as regarding rice Mr. Huntington has a good deal to say.

The places where there are dense populations, the rice regions and the manufacturing regions, the rice regions contain by far the greater number of people. The rice type of dense population is represented in most of China, much of India, in the plains of Burma, Siam and Indo-China, in Egypt, and in the islands of Java, Philippines, Formosa and Japan. Rice is a cereal which feeds more people than does any other single crop, and it has an extraordinary capacity for supporting a large population on a small area. In Java, for instance, the average yield per acre is something like 2,000 pounds of rough rice, Javanese rice-land supplies four to six times as much food per acre as wheat-land in the United States, and similar, although less extreme, conditions prevail in China, Japan, India and Egypt. Rice is free from certain disadvantages which hamper other kinds of agriculture in the tropics, it is comparatively immune from pests, irrigation helps to maintain the fertility of the soil, rice-fields are almost free from weeds, and can be ploughed with crude implements and comparatively weak animals. The conditions which enable a country to support a maximum number of people without help from outside include level plains, rich soil, high mountains, high temperature and abundant sunshine, and a bountiful supply of water in the form of either rain or rivers. Level land is desirable, but not essential, as it can be terraced. Good lowland but not water-logged soil is obviously important, and on the best soils of the lowlands in Java the rural population, omitting the towns, reaches the intensity of over a thousand persons per square mile. In one area of eight hundred square miles this rises to fifteen hundred, and in another area of three hundred square miles to nearly seventeen hundred. Nowhere else in the world will so many people be supported in a given area. High mountains play their part in supplying water and in preventing soil from being exhausted by carrying fresh fertile soil to the plains. There are still many tracts in the world suitable for rice cultivation which are not so cultivated, and the author calculates that if rice cultivation spread as far as the circumstances permit the world's population might be raised by fifty per cent.

But there is another point which affects the question of the world's food supply. The people of the tropics have, generally speaking, little initiative and are quite content to raise products in sufficient quantities for their own consumption, in other words, whatever they may require in the way of food, they aim at being just self-supporting. It is the white man who for purposes of trade stimulates production, and he does so in many other ways than in that of food supplies. It may be rubber that he aims at, or the fibres, or tea, coffee, tobacco, quinine and other things; and in places in the tropics where the people were once self-supporting, they have been attracted away from the cultivation of their own lands to plantations for the sake of the good wages offered. Food has then to be brought from somewhere else, corn has to be imported in the ships which carry away rubber, sugar, tea or as the case may be. The labourers employed on raising products of little or no food value have to be fed, and although cultivation in the tropics may be enormously increased, development of that kind does not increase the world's food supply, it may be, in fact, just the opposite. It may of course be possible that, in course of time when nutriment is a greater need than it is at present, the enterprise of the white man may lead him to embark on food culture in the tropics in ways at present unknown, but that has not come yet. "The Human Habitat" is a thought-provoking and instructive work, dealing with many questions with which we are concerned, and it is well worth reading.

Notes and Comments.

Bengal-Nagpur Railway.—At the last meeting of the Local Advisory Committee of this Railway, presided over by the Agent, he said that the total audited earnings for the financial year 1927-28 were not yet available but the indications were that they would approximate Rs. 905 lakhs, or Rs. 73 lakhs more than the previous year.

Unfiltered Water Supply for South Calcutta.—The Calcutta Corporation, at its meeting on the 10th instant, sanctioned the construction of a 12-inch unfiltered water main connecting with the pipe system supplying Bhowanipore at an estimated cost of Rs. 51,000. This, it is expected, will give speedy relief to Southern Calcutta regarding its unfiltered water supply.

Parasite-proof Concrete.—A report recently issued by the Kansas City Testing Laboratory states that a type of concrete has been devised which is specially able to resist the growth of fungus, vegetable and animal parasites. It is claimed that the concrete is the best available material for resisting the destructive influences of parasitic growths and is particularly advantageous for the construction of water conduits and structures in contact with sea water.

Lahore Power Station.—The new power house of the Lahore Electric Supply Co., Ltd., in the industrial suburb of Shahdara, 4 miles from Lahore, has now supplanted the old one which was located in the Lahore Civil Station, and supplies current to the whole of Lahore. The plant comprises two dynamos each generating 3,150 killowatts at a voltage of 6,600, but only one of the dynamos is actually in use, the other being kept in reserve against future demand.

Staff Changes, B.-N. R.—Mr. A. M. Clark, District Traffic Superintendent, attached to the office of the Superintendent, Rates and Development, is transferred to Nagpur as District Commercial Officer. Mr. A. C. Chatterjee, Acting District Commercial Officer, Nagpur, reverts to Assistant Commercial Officer, Nagpur. Mr. S. R. Das, Assistant Commercial Officer, on leave, has, on expiry of the leave, been attached to the office of the Superintendent, Claims. Mr. L. M. Mozumdar, Assistant Commercial Officer, Adra, has been transferred and attached to the office of the Superintendent, Rates and Development.

New Air Cooling System.—The time is now contemplated when fans and electric contrivances will become obsolete, and their place in public buildings, offices, etc., be taken by a new cooling system, which is already in operation in some large industrial buildings in India. Briefly the system consists in drawing air from a room to pass through a chamber into which hundreds of small nozzles are each spraying a cloud of cold water. In passing through these sprays the air and the water vapour which it contains are cooled to a point where much of the initial moisture is condensed into the spray water. Thoroughly cleansed and dehumified the cooled air is delivered to the room through metal ducts in the roof, and virtually fall to lower levels and passes over the occupants so gently that there is no sense of draught. Fresh air is always being added to that which is drawn from the room. At present the cost of installing and running the necessary apparatus in flats or houses is a prohibitive one, but investigations are being made to discover a modified plant that will bring it within reach of those moderately wealthy.

On the Nile.—An excellent testimony to the satisfactory service given by British machinery is afforded by the electric lighting plants installed on Messrs. Thos. Cook and Sons' Nile steamers. As long ago as 1906 Greenwood and Batley, Ltd., of Leeds, supplied the first turbine-dynamos for these boats, and since then have installed similar sets on over 30 of the company's steamers. Naturally, the outputs of the lighting plants vary with the size of the steamers, and range from 7 h.-p. (4·4 kw.) to 30 h.-p. (20 kw.) capacity. Among the steamers so equipped and which are well known to visitors to Egypt are the "Egypt," "Luxor," "Kassala," "Thebes," and "Notocris."

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 2nd May 1928:—Messrs. Worthington-Simpson, Ltd., Calcutta—10 Valves, sluice, standard, heavy water works pattern, 12 inches, Rs. 2,150, free delivery at Simla by 3rd September 1928; 14 Valves, sluice, standard heavy water works pattern, 6 inches, Rs. 1,071, free delivery at Simla by 3rd September 1928; Spare parts, for pump axiflow, Rs. 1,481 f. o. r. Howrah; Messrs. Martin and Co., Calcutta—Spares, for Dragline excavators, Rs. 2,310 c. i. f. Karachi; Messrs. Parry's Engineering Ltd., Calcutta—80 pairs Wheels, disc, cast steel, Rs. 1,120 c. i. f. Stewart Sound; 160 Boxes, axle, Rs. 1,240 c. i. f. Stewart Sound; Messrs. Turner, Hoare and Co., Ltd. Bombay—Spare parts, for Lee Howl horizontal treble ram pump, Rs. 2,554, free delivery at Jamrud.

Supercharging Goes to Sea.—From the installation of a marine engine having many characteristics in common with a motor car, it is not a far cry to supercharging the same type of engine, with a view to getting more power and speed out of the ship, just as a motor car is supercharged for the same purpose. The first British-built motor ships to have their Diesel engines supercharged are three which have recently been built by William Beardmore and Co., Ltd., for a Brazilian line. The engines are two Beardmore-Tosi 6-cylinder Diesels of 1,800 h.-p. each. The supercharging blower is driven by steam turbine and has a capacity of 13,700 cubic feet of free air per minute. On trials without the supercharger the average speed attained was 14·1 knots, and the total brake horsepower 3,320. With the supercharging gear in action the average speed rose to 14·826 knots and the B. H. P. to 4,072. The trials are considered by experts to be ample justification of the claims made for this latest type of marine installation.

The Shipping Industry.—In connection with the Bill introduced in the Legislative Assembly further to amend the Inland Steam Vessels Act, 1917, the Committee of the National Chamber of Commerce, Calcutta, state that the object of the intended legislation meets with their approval. In their letter to the Government of Bengal, they point out that the intended legislation should be such as not to unnecessarily interfere with trade, and if the main object of the proposed legislation is to foster indigenous shipping industries, then the question of determining

rates of freight and fares should arise only when an application is received from any *bonâ fide* indigenous company for such determination. In one very important respect the Government can render help to indigenous shipping industry by allowing facility of through booking with railways to important Indian shipping companies, on the same terms and conditions as at present exist between the railways and the European steamship companies.

Concrete Buildings in Race toward Sky.—A distinct trend toward the use of reinforced concrete for high buildings is revealed by a recently completed American survey. The highest concrete buildings are to be found in South America, the Hotel Palacio Salvo at Montevideo, Uruguay, being the highest building of its type in the world. It rises to a height of 28 storeys, with its peak 338 feet above the road level. The Palacio was finished in 1926. The tallest concrete building in the United States is the recently completed Master Printers' Building, New York, which has 20 storeys and an over-all height of 310 feet. The first concrete building above ten storeys was erected in Cincinnati in 1903 and is 16 storeys high. The average number of storeys for the 647 reinforced concrete buildings in America ten or more storeys high is 11·9. The survey attributes the rapid increase in use of the tall reinforced concrete frame to the properties which concrete possesses of being economical, fireproof, and also to the speed of erection it makes possible.

Railway Earnings.—A general increase is recorded in railway earnings and goods traffic during the week ended 28th April 1928. The total approximate gross earnings of all State-owned railways for the week amounted to Rs. 222 lakhs or Rs. 7 lakhs more than the figures for the previous week and Rs. 12 lakhs more than the figures for the corresponding week of the previous year. The total approximate gross earnings up to 28th April 1928 amounted to Rs. 2·71 crores or Rs. 39 lakhs more than the figures for the corresponding period of the previous year. A comparison with the figures of the previous week shows increase in approximate gross earnings of all railways except G. I. P. and N.-W. R. On class I railways during the week 91,519 wagons were loaded on broad gauge (7,254 more than in the corresponding week of 1927) and 58,270 on metre gauge (5,184 more than in the corresponding week of 1927). From 1st to 28th April 1928, 33,594 wagons more were loaded on broad gauge and 27,704 more on metre gauge than in the corresponding period of last year.

Improvement Trust and Corporation.—The Chairman, Calcutta Improvement Trust, has written to the Chief Executive Officer, Calcutta Corporation, pointing out that the improvement of Manicktola is included in the programme of urgent works to be undertaken by the Trust, and the Board are now in a position to commence operations as soon as they can do so. They cannot, however, take any steps until the Corporation has come to a decision on certain questions relating to the scheme for the drainage of Cossipore-Chitpore and Manicktola. The Board have no information as to the progress made in the preparation of the detailed scheme, but they stress the importance of arriving at an early decision, and request that if it is not possible to do this at once, they may be informed how matters now stand. The Drainage Engineer reports that although he has been working on special duty for eighteen months, in addition to the duties of Executive Engineer, Drainage, he has not yet been granted the facilities in the way of emoluments or staff as resolved by the Corporation when they adopted the report of the Bidyadhari Committee. It has, therefore, not been possible to work out the scheme in detail as required by them.

New British Fast Launch.—A seven-seater 24-feet Runabout, with a speed of over 30 miles per hour, from a 100 h.-p. standard type marine engine at a moderate price, is one of the latest outlets for the enterprise of that well known British motor boating firm, Messrs. J. W. Brooke and Co., Ltd., of Lowestoft. Arrangements have been made to produce the boat on a thoroughly standardised and extensive basis with up-to-date equipment and controls on strikingly motorish lines, such as this firm is doing in connection with their popular "Empire" 18-feet Runabout. The boat which will sell in England at £750 complete, should soon gain the popularity its smaller sister craft has established Overseas. Incidentally its power unit, the new Brook 40/100 h.-p. "Silent Six," a super modern British marine motor with many new features will, we predict, have an excellent Overseas acceptance. We shall not be surprised to see both these new productions featuring extensively in the many orders this firm is receiving from South America, Germany, Holland, Africa, India, Australia, New Zealand, and other foreign countries on whose seaboard and waterways British motor craft, and British engined boats are giving such a good account of themselves.

Assam-Bengal Railway.—The fifteenth meeting of the Local Advisory Committee of this Railway was held at Chittagong on 25th April last. The Agent, presiding, said that there was a total increase over the preceding year of Rs. 29,08,251 in all. On the position regarding the various new railway projects in hand and contemplated and on the additional rolling stock and engines, which had been sanctioned for the railway during the current year, the Agent explained, that although 100 extra goods wagons had been sanctioned, he had requested the Railway Board to sanction an additional 350 wagons and trucks. He further informed the meeting that a survey for a bridge over the Meghna river at Bhairab Bazar was now being carried out, and that the Government of Bengal had convened a meeting to be held at Bhairab Bazar under the chairmanship of the Commissioner of Dacca, at which representatives of the Railway Company and the Steamer Companies would be present to consider what headway and waterway should be provided. It was hoped that the work would be taken in hand without delay. He expected the construction of a railway from Gouripur (Mymensingh) to Gauhati would be discussed at the next meeting of the Assam Railways and Steamer Communication Board to be held to-day. So also would be discussed the proposed railway from Srimangal to Manumukh. Several other subjects were discussed.

Suri Waterworks Scheme.—Designed to supply a population of 12,000 with 120,000 gallons of water daily, the Suri Municipal Waterworks, constructed by the Engineering Branch of the Public Health Department, Bengal, have now been put into operation. The water is obtained from the river Mayurakshi, some 2 miles from the town. From investigations

made it was ascertained that a filtration gallery 85 feet long would yield the quantity required. On the bank of the river is a well 6 feet in diameter and 28 feet deep. From a point near the bottom of the well a 9-inch pipe line runs out towards the river, the end of the pipe in the well being controlled by a sluice valve. The level of the pipe is about 11 feet below the surface of the sand in the river bed. The portion of the pipe line laid through the sand consists of perforated earthenware pipes, and this length is surrounded with gravel. The water from the sand passes through the gravel into the pipes and along to the well, and although the surface flow in the rains is very impure, the water drawn from the filtration gallery 11 feet below the sand level is always good. The gallery can be extended later on if required. Water is delivered to the town from the well by triple ram pumps driven by oil engines of 12 horse-power. There are duplicate pumps and engines, each being capable of lifting 7,500 gallons per hour against a total head of 185 feet, through a 6-inch rising main 2½ miles long. The engines and pumps are housed in a building placed on rising ground near the river bank at a level above the highest known flood. The whole scheme is not yet finished. An elevated reservoir of 73,000 gallons capacity is to be constructed into which the rising main will discharge, and the distribution pipe lines are to be extended. In the meantime, however, the town is being supplied by a direct connection between the rising main and the distribution system.

Catering for those on Leave.—There are many who, when home on leave, wish to purchase either a new or second-hand car for the duration of their visit, but to whom the difficulty of disposing of the car when they return, and the consequent financial loss, has seemed too great to permit the realisation of their wishes. With this in view, Messrs. Shaw and Kilburn, the well-known London Car Distributors, have devised a scheme whereby visitors can determine within narrow limits the actual cost of owning a car whilst on leave. The most important facility offered is that of guaranteeing, at the time of purchase, a fixed price at which the car will be bought back at the end of a definitely stated period. This relieves the visitor of all anxiety as to his main outlay and expenditure, and enables him to use the car up to the last days of his leave without the worry and responsibility of disposing of the car, personally, which would place him in the difficult position of having to accept the low price resulting from a forced sale. The Sales organisation of Shaw and Kilburn can further relieve him of all worry in connection with the registration of his car for road use, can take the necessary steps to obtain his British driving licence and generally assist him in a variety of ways to a very great degree. Secondly, there is the question of running expenses, for the secret of inexpensive motoring is to keep the car constantly in tune. Frequent inspections of the vehicle by skilled engineers, and the execution of minor adjustments at regular intervals, will save the costly replacements made necessary by neglect. The Works Department of Shaw and Kilburn, Ltd., has been built up with this in view. A Service Department on the ground floor of their Wardour Street premises is specially equipped for the carrying out efficiently and quickly of such minor adjustments as any car must need from time to time. Neglect of such points as adjustment of brakes, oiling and greasing, tuning of the carburettor, setting of the tappet clearance and the like, will considerably lessen the efficiency and life of the car, whereas attention to these is a matter of a few hours' work and a few shillings' expenditure. Visitors purchasing cars through the Shaw and Kilburn organisation are offered a free monthly inspection and report of their cars with the sole object of reducing the cost of upkeep. The situation of their premises in the heart of London, three minutes from Piccadilly Circus, will be found a great asset, and visitors will be well advised to acquire in advance a copy of an interesting booklet they have issued dealing with the Sales and Service side of their organisation.

Profit-sharing in the Motor Industry.—To produce the popular British light car at the value for money that it offers to-day, it is obvious that everyone concerned must pull his weight. There is no room for passengers in this department of industry. British motor manufacture has provided many instances of hard work bringing its just reward, but few more striking than that of Messrs. Singer and Co. As is well known, the financial strength of the Singer Co. is enviable. The shares have reached an almost record height. At the end of last year, after paying for the purchase and equipment of immense new works on the outskirts of Birmingham, and other extensions, and allocating £104,000 to the shareholders, the reserves still amounted to £678,700, *i. e.*, still more than the whole of the share capital. That this Singer success has not been achieved at the expense of the employees is revealed by the figures of wages paid, which are perhaps the most striking feature of last year's trading. The total wages bill was close on half a million. If, however, they had paid merely Trade Union rates this would have been £72,000 less, *i. e.*, the company would have been so much better off themselves. As it was, they paid the difference—roughly 20 per cent. more than they need have done—to the workers. This amounts to profit-sharing with the employees. It means that, for instance, while a man holding 100 Singer shares (value over £300 to-day) received £20, the average worker received £24, or nearly 10*s.* per week, above the usual or Trade Union rate. Furthermore, the workers receive this money weekly, in advance of the shareholders ; the latter have to wait to see if there is a profit before they receive anything. This is the result of a system which does much to breed confidence in the management. Employees in the Singer shops are on "piece-work," as opposed to time ; that is they are paid so much for each article they turn out instead of so much for each hour they are in the Works. The usual objection to this system, from the workers' point of view, is that as soon as a man becomes proficient at his various operations, and begins to speed up and make money, there is a temptation for the employer to lower the rate per article as soon as what he thinks is a reasonable total weekly wage has been reached. Now the Singer people get over this difficulty by going into the piece-work rates at Round Table Conference with the workmen themselves every July, that being the beginning of the slack season, when plans are being made for the next season's output. The rates for each job are then fixed and a guarantee is given that they will not be altered for 12 months.

Current News.

MR. H. C. SPARKE acts as Member, Railway Rates Advisory Committee.

DR. J. COGGIN-BROWN has been appointed Technical Adviser, Tariff Board.

MR. A. D. BUTTERFIELD is appointed to officiate as Chief Auditor, Eastern Bengal Railway.

MR. L. BIGG-WITHER has been confirmed, provisionally, as Chief Mechanical Engineer, G. I. P. Railway.

MR. ALI AHMAD, Executive Engineer, P. W. D., Assam, has been granted extension of leave for five weeks.

MR. F. T. DE MONTE is appointed to officiate as Chief Engineer, Telegraphs, *vice* Mr. E. L. Bagshaw, granted seven months' leave.

MR. W. SINCLAIR, I. S. E., Executive Engineer, P. W. D., United Provinces, has been granted commuted furlough for eight months from 1st April.

THE Winnipeg Electric Company has contracted to supply 30,000 horse-power at half a cent per kilowatt-hour or 13·8 dollars per horse-power per annum.

MR. J. N. MUKERJI is appointed to officiate as Director, Telegraph Engineering, United Provinces Circle, *vice* Mr. M. E. Nigel-Jones, granted six months' leave.

MR. E. P. BURKE, Executive Engineer, P. W. D., Assam, has been appointed to officiate as Superintending Engineer, *vice* Mr. M. Little, granted six months' leave.

IT is understood that His Excellency the Viceroy will open the next session of the Indian Industrial and Commercial Congress to be held in Calcutta during Christmas week.

MR. S. C. STUART-WILLIAMS, Chairman of the Port Commissioners, Calcutta, who has gone home on leave, has resigned his seat as a Councillor of the Calcutta Corporation.

THE next annual session of the Indian Railway Conference will begin in Simla on 6th October next under the presidency of Mr. N. Pearce, Agent, Eastern Bengal Railway.

BRITISH imports in April this year totalled £96,797,000 and exports, £55,268,000. These figures are less than those for March 1928 by £13,714,000 and £9,690,000, respectively.

MR. E. MILLER and Mr. W. G. Lely are elected to the Bombay Legislative Council by the Bombay Chamber of Commerce in place of Sir Leslie Hudson and Mr. G. I. Winterbotham.

THE Madras Government will shortly open Industrial Schools at Mangalore, Bellary and Calicut, where instruction in motor mechanism, smithy and cabinet making, etc., will be given.

IT is proposed to control the head waters of the Clarence River, New South Wales, for the purposes of flood protection and power production, at a cost of about three-quarters of a million sterling.

THE Government of India have sanctioned the construction by H. E. H. the Nizam's Government of a railway on the 5 feet 6-inch gauge, from Vikarabad to Bidar, a distance of 56·31 miles.

SIR BRADFORD LESLIE having proceeded to Europe on three months' leave, the Government of Madras have appointed Mr. F. B. Wathen, Agent of the M. and S. M. Railway, as Chairman of the Madras Port Trust.

THE Meteorological Service of Canada has established a weather bureau at St. Hubert Aerodrome, near Montreal, under the direction of the Naval Service, in connection with the proposed Transatlantic air service.

THE tank steamer "San Jeronimo," of 12,000 tons, has been bought from the Eagle Oil and Transport Company by a whaling company for conversion into a depôt ship. She will work in the southern seas in company with three catchers.

THE Kabul-Tashkent air service has begun to function regularly. Accounts received from Kabul show that the service is becoming increasingly popular and there is every prospect of its attracting more custom. There are two voyages monthly either way.

THE Canadian Forest Products, Limited, backed by the International Harvester interests of Chicago, will be allowed to erect a 200 feet dam on the Nimpkish and to flood areas around Nimpkish Lake in the development of their power scheme.

PRESIDENT COOLIDGE has signed the Mississippi Control Bill, committing the Government to the herculean task of curbing the flood-waters of the Mississippi, probably one of the greatest engineering enterprises ever undertaken. This will cost over £60,000,000.

DURING 1927 the port of Beira, Portuguese East Africa, handled 820,624 tons of cargo, an increase of about 27 per cent. over the best previous figures—1925—and 60 per cent. above the cargo movement of 1923. Last year's traffic was almost three times that of 1913.

THE Madras Corporation has resolved to raise a loan of Rs. 10 lakhs from the Government for improving slum areas in the city, expressing their readiness to resort to higher taxation, if necessary, for repaying the loan. It also sanctioned an expenditure of Rs. 10,000 for preliminary survey of the work.

Literary Notices.

Properties of Materials at High Temperatures.—3-Note on the "Creep" of Armco Iron. By H. J. Tapsell, A. C. G. I. This is Special Report, No. 6, Engineering Research, Department of Scientific and Industrial Research. In continuation of the research in the properties of materials at high temperatures, which is being carried out at the National Physical Laboratory for the Engineering Co-ordinating Research Board, experiments have been made which illustrate certain features of the creep of Armco iron. It is considered that this work provides useful information relating to the general phenomena of creep, and an account of it is therefore given in the present report.

Baldwin Locomotives.—This is the title of a quarterly magazine published by the Baldwin Locomotive Works, 500, North Broad Street, Philadelphia, U. S. A., whose local offices are at 5, Dalhouise Square, East. The number before us is that for April 1928. It is a richly illustrated and extremely well got up magazine, and although its pages are in the main devoted to the products of the Baldwin Locomotive Works which is the reason for its publication, the information provided is most instructive. Baldwin locomotives are known the world over and there is good reason therefore for full particulars regarding them. The contents of the present number read as follows:—A history of Baldwin Locomotives in New Zealand; An epochmaking event; Motive power development in the Denver and Rio Grande Western Railroad; The Southwark-Emery spring testing machine; Industrial electric locomotives; Baldwin veterans on Brazilian railways; A recent locomotive; Locomotive frames, and lastly Baldwin locomotives on the Delaware, Lackawanna and Western Railroad. Locomotive engineers will find much of interest in this magazine.

Report of Test by the Director of Fuel Research on the Crozier Retort Installed by Mineral Oils Extraction, Limited, at Wembley.—Tests carried out 4th to 9th April 1927. Department of Scientific and Industrial Research. Price 9*d*. net. Copies may be obtained from Messrs. Thacker, Spink and Co., Calcutta.

Mr. C. H. Lander, Director of Fuel Research, writes in his Prefatory Note, as follows:—The Department of Scientific and Industrial Research has been empowered by the Government to make tests at the public expense of plants for the low temperature carbonisation of bituminous coal. A copy of the published conditions for such is reproduced as an appendix. The object of these tests is to place in the hands of those interested, accurate technical data on the quality and quantity of yields, the throughput of the plant, the working temperatures, and the general ease of working, together with such other information as it may be possible to obtain under the limited conditions of the tests. It should be clearly understood that no attempt is made to pronounce on the commercial possibilities of plants which may be tested. The likelihood of commercial success can only be finally judged after working a plant under a steady load for a long period, and in the light of complete knowledge of local conditions such as cost of raw material, quantity of raw material available, price and markets for products, cost of labour, etc. The present report describes the test of a unit "Crozier" retort erected in the grounds of the British Empire Exhibition at Wembley. The retort is of the continuously working vertical type and is based on a similar plant erected in Burma for the treatment of oil shales. The coal used for the test was a Scottish splint coal, and, with the heating adopted, the throughput was about 4 tons per day. A modification in the heating arrangements to produce a more even temperature distribution would increase the throughput and the yield of tar per ton of coal, and at the same time tend to lengthen the life of the retort. When allowance is made for certain difficulties in working the plant under test-conditions, it would appear that the retort should work satisfactorily, provided the coal is of such a type that the separate pieces do not coalesce unduly on carbonisation, and that it should produce satisfactory yields of coke, tar and gas, provided the heating arrangements were suitably modified. This should present no great difficulty. The coke produced during the test was of smaller size than the coal charged, but the amount of breeze (under ½ inch) formed was not excessive.

Foreign Notes.

Preheated Air for Boiler Furnaces.—Mr. P. H. N. Ulander has found that the use of preheated air results in higher furnace temperatures and increased radiation, making possible a reduction in the size of boiler and the size of the heating surface. Also a higher furnace rating can be maintained without serious loss due to incomplete combustion. Troubles such as "burning" of the links in a chain grate, uneven combustion, erosion of furnace walls, etc., may arise if preheated air is used in connection with old-type furnaces and grates, but with correctly-designed plant it is possible to operate safely with air temperatures of 250 degrees or even higher.

Steel Houses in Germany.—To meet the increasing demand for steel houses throughout Germany, the Vereinigte Stahlwerke A.G. has founded a new company, the Stahlhaus-Baugesellschaft m. b. H., with headquarters at Duisburg, for the production of fabricated steel houses. The present capacity of the new company is set at about 1,500 houses per annum, but as the demand is already considerably in excess of that figure, production is to be increased. The new organisation is associated with the Bamag-Meguin, the Berlinische Baugesellschaft and the Gebrüder Achenbach (Weidenau) for the marketing of its product. The Rheinstahl concern has published estimates for three sizes of houses (8 m. by 8 m., 8 m. by 9·5 m. and 8 m., by 12 m. respectively, in plan), the costs of which are given as 6,900 mks., 8,460 mks. and 9,780 mks. respectively, exclusive of land and payments for roads.

Iron and Coal in Persia.—The report of an expert employed by the Persian Government to investigate the mineral resources of the country has disclosed the discovery of iron ore deposits in Somnan sufficient to meet Persia's needs for twenty years, together with seams of coal estimated to contain thirty years' supply. It is estimated that $12,000,000 will be required to establish blast furnaces, a rolling mill and an iron foundry on a large scale, but that a smaller unit could be established for $4,500,000. It is stated that the Government is prepared to build this latter installation. The same expert, in a report submitted at the end of December, advocated the building of an aerial ropeway from Shamshak, in the near-by Elbura Range, to Teheran, for the purpose of bringing coal to that city. As the capital's entire coal supply is still dependent upon animal transport, with its ensuing high cost, it appears that the Government will favour this ropeway and that work on this project may begin before the end of 1928.

Proposed New Railway in Canada.—Reports are current in Canada that the British syndicate headed by Lord Gainsford and Sir George Courthope, which is planning to spend many millions of dollars in industrial development in the province of Quebec, will build a railway from St. Felicien to Lake Chibougamu. This will be one of the biggest developments ever undertaken in the province. Lake Chibougamu is the centre of what is claimed by geologists to be one of the biggest copper mining fields in the Dominion. It is situated about 200 miles from St. Felicien, in the Lake St. John district. This project is entirely separate from the St. Felicien to Mistassini railway scheme, which the same syndicate will undertake. The Quebec Government some time ago granted a subsidy of 192,000 dollars for the St. Felicien-Mistassini line of 32 miles in length, and a further 375,000 dollars for the continuation of the line to Chute-a-Caron, on the Saguenay River, where the big plant of the Aluminium Company of Canada is being erected.

A Huge Concrete Structure.—A concrete silo, constructed at Port Arthur, Ontario, with a capacity of 5,500,000 bushels, presents features of more than ordinary interest. The structure consists of 112 rounds tanks 23 feet in diameter. Short connecting walls running between these form a number of smaller bins or containers. The aggregates used consisted of trap rock, washed and sized, 65 per cent. being retained on the ¼-inch but passing 1½-inch screen and 35 per cent. passing the ¼-inch screen. To five parts of these combined aggregates one part of fine sand was added to make the concrete more workable. The average shrinkage on this work was between 4 inches and 5 inches and the concrete produced had an average compressive strength of over 2,500 lb. per square inch in twenty-eight days, though the design only called for a 2,000 lb. concrete. The construction of this elevator required 100,000 barrels of Portland cement, 2,000 tons of reinforcing steel, 2½ million feet of form lumber, 1¾ million feet of timber for trestles, 558 climbing form jacks for each storage tank, and 90,000 cubic yards aggregate.

Preparation of Methyl Alcohol of High Purity.—Some investigations carried out by Messrs. W. K. Lewis and P. K. Frohlich at the Massachusetts Institute of Technology, and described in "Industrial and Engineering Chemistry," has shown that methyl alcohol of high purity may readily be prepared by passing a mixture of carbon monoxide and hydrogen, preferably at a pressure of several hundred atmospheres and at temperatures between 300 deg. and 350 deg. Cent., over a catalyst composed of metallic oxides. With a catalyst of medium activity prepared from the oxides of copper, zinc, and aluminium, it is possible to reach nearly theoretical conversion depending upon the pressure, temperature, and rate of gas flow employed. The catalyst, consisting of the oxides of copper, zinc and aluminium supported on metallic copper, appears to be most active at lower temperatures and suffers a permanent decrease in activity when exposed to higher temperatures. Also the catalyst is sensitive to poisons. By connecting several chambers in series, however, it is possible to dispose of the catalyst poison in the first chamber, thus protecting the contact material contained in subsequent reactors.

North to South Railway of Persia.—A trunk line has been the goal of Persian nationalist ambition for many decades past. It has been brought somewhat nearer to realisation by the passage of the sugar and tea monopoly law on 30th May 1925, which created a railway fund by the application of a surtax of 2 and 6 krans, respectively, on every batman (6½ lb.) of sugar and tea brought into the country. An American railway mission has appeared on the scene, and on 24th February 1927, the Mejlis authorised the Government "to begin from both ends the construction of a railroad between Khur Musa or Mohammerah and Bandar-i-Gaz *via* Hamadan and Teheran." It is too early as yet to expect accurate estimates, but it seems that the construction of a sea-to-sea railway may take from seven to ten years at a cost approximating £15,000,000, while it may be 30 years before the railway pays its way. No decision has yet been taken (20th November 1927) in regard to the negotiation of the Elburz range, a formidable obstacle. The southern terminus at Khur Musa also necessitates the construction of an entirely new port. The call for tenders made in September 1927 was in respect of sufficient material for 100 miles of 4 feet 8½-inch gauge line at each end. This will allow the Railway Mission to gain a rough idea of the likely cost of construction over the whole length, and when that has been made it is likely that foreign contractors will be invited to build the more difficult sections of the line.

Electrical Propaganda in France.—The consumption of electricity in France is generally keeping pace with the supply, which is growing so rapidly with the carrying out of hydro-electric schemes that it is feared it will largely exceed requirements unless something is done to stimulate consumption. In industrial centres electricity is superseding all other forms of motive power, largely on account of its convenience; but it is not usually economical unless the user can increase his consumption sufficiently to secure the full rebate, and even then the cost is appreciably above that of energy supplied by a suction gas or oil engine plant. The cost of electricity is, in fact, higher than had been promised when the electrification scheme was started with the idea that in time the whole country would be supplied with a cheap as well as a convenient form of energy. Too little account had been taken of the cost of distribution and maintenance, which far exceeds the original estimates, and the companies are therefore hoping to bring down the price to consumers by opening up new sources of consumption. The greatest scope lies in encouraging the use of commercial vehicles with secondary batteries which could be re-charged at night at low cost, and trials have been organised from time to time to demonstrate the economy of that form of motive power, especially in view of the new fiscal legislation which tends to increase the price of imported liquid fuels. The plan of the electricity companies is to popularise the electric commercial vehicle, so as to provide a continuous fall load on the power stations and also eventually to install automatic re-charging stations along the roads to permit of electric vehicles running all over the country.

Experimental Locomotives for South Africa.—Among the latest developments in locomotive practice for South Africa are the 2-8-2 type engines built for experimental purposes by a leading firm in Germany, says the "Railway Gazette." These are three-cylinder single-expansion locomotives, and, we believe, represent the most powerful of the fixed-wheelbase type yet built for the 3 feet 6-inch gauge. These engines each develop a tractive power of 53,200 lb. at 75 per cent. of the boiler pressure, which is 215 lb. per square inch. The new engines, which belong to "Class 18," have been introduced for working coal traffic on the Germiston-Witbank section, 80 miles in length, and it is anticipated that they will be able to deal with trains of 1,800 tons behind the tender on up grades of 1 in 100. Some of these grades are from 3 to 5 miles in length, and with the present locomotive power the round trip of 160 miles occupies 11 hours, a timing which it is hoped materially to reduce. The section incorporates long stretches of single track, and the traffic over it is of a heavy character. This is another remarkable example of what can be done in the way of building large and powerful locomotives for a narrow gauge, and it is of interest to note that, owing to the fact that the grate area is 60·3 square feet, mechanical stoking apparatus has of necessity been fitted. The boiler is of exceptional size, measuring 6 feet 6¾ inches diameter, with a length between tube-plates of 20 feet 7 inches, a total heating surface, with superheater, of 4,245·8 square feet being afforded. The South African Railways have for many years past been noteworthy for the interesting locomotive types placed in service thereon, incorporating the well-known Garratt articulated engines, others of the Mallet type, and large units with fixed wheelbase varying in type and capacity, thus aggregating a locomotive stock which to the student of locomotive practice is one of the most interesting in the world.

British-American Locomotive Comparisons.—According to the "Railway Gazette," in replying to the discussion on his paper before the Institution of Mechanical Engineers, entitled "A Three-Cylinder Compound Locomotive," Mr. Lawford Fry made some interesting comparisons between the Baldwin locomotive No. 60000 and the "Royal Scot" engines of the London Midland and Scottish Railway. He remarked that the President of the Institution, Sir Henry Fowler, had given some interesting figures for the coal and water consumption of the "Royal Scot" engines, and in so doing had pointed out that as these were based on drawbar horse-power they were not directly comparable with the figures given in the paper, which were in terms of indicated horse-power. Drawbar horse-power is, of course, the measure of the useful power of a locomotive, but as the author's main object was that of studying the action of the steam in the cylinders, all data therein were based on indicated or cylinder horse-power. The figures relating to coal and water consumption per drawbar horse-power-hour as presented by Mr. Lawford Fry were instructive, and interest is created by comparing them with those secured with the new L. M. S. "Royal Scot" class. For Baldwin locomotive No. 60000, with high-pressure cut-offs ranging from 60 to 90 per cent., the steam consumption per drawbar horse-power-hour ranged from 17·3 to 20·1 lb., whilst the figure for the "Royal Scot" was 22·3 lb. The high boiler pressure and compound cylinders of the American locomotive were evidently effective in promoting utilisation of the steam. The coal per drawbar horse-power-hour for No. 60000 averaged 2·5 lb., against the minimum of 2·66 lb. for the "Royal Scot." Differences in the character of the fuel have, of course, to be taken into account, and it must be remembered that British coal has a slightly higher heating value and probably possesses physical advantages for which, as Sir Henry Fowler had pointed out, no methods of measurement are at present available.

General Articles.

STRENGTH OF LONG WALLS.

By G. C. Banerji, Late Executive Engineer, P. W. D., Bengal,
Consultiug Engineer, Alipore, Calcutta.

ENCLOSURE walls, as constructed, may be divided into two groups :—

(1) *Short walls.*—That is walls whose unsupported length *is less than ten times* the height. Walls of this nature receive considerable support from the ends and thus they are in a different position from what are termed

(2) *Longs walls.*—Walls whose unsupported length *is more than ten times* their height, and are independent of the end supports, their strength depending upon the nature of construction of the walls themselves.

As an example of long enclosure walls may be taken jail compound walls and so on. For the purpose of calculation the wall of the Central Jail, Calcutta, has been taken and the wall is shown *in section* in the drawing on the opposite page.

The co-ordinates of the centre of gravity of the section, taking the ground line GL and the vertical line OY as the axes of X and Y are

$$X = 10{\cdot}85 \text{ inches.}$$
$$Y = 80{\cdot}17 \text{ inches.}$$

Also the moment of inertia (I) of the horizontal section at oo′ = 16441·75.

The external force to which such a wall may occasionally be subjected tending to destroy its stability is the wind pressure which acts at the centre point of the wall and its value is 15P over a foot length of the wall where P is the pressure of wind in cwt. per square foot.

When this wall is acted on by wind pressure the action of the wind will produce tension on the windward side at o′ and compression on the opposite side at o′, the wall being in the position of beam fixed at one end at the joint oo′.

Thus the moment of flexure produced by the wind

$$\text{pressure} = \frac{15P \times 15 \times 12}{2} = 1350\ P \ldots\ldots\ldots\ldots\ldots(1)$$

The counteracting "moment of resistance" is given by the expression $\frac{I}{X} r_o$.

Where I = moment of inertia of the horizontal section at oo′ = 16441·75.

X = distance of the extreme fibre in tension at o from the neutral axis = 10·85 inches.

r_o = adhesive strength of mortar to brick at the joint oo′.

Suppose the wall is built with the "best hydraulic lime" $1\frac{1}{2} : 1$ mixture. This mortar has a safe adhesive strength of 0·25 cwt. per square inch after 12 months.

Thus $r_o = 0{\cdot}25$ cwt. per square inch.

But as this resistance offered by tension is supplemented by the moment of the weight of the wall, which if denoted by m_o, the correct value of r_o becomes $m_o + 0{\cdot}25$ cwt. per square inch or $r_o = m_o + 0{\cdot}25$.

Taking the weight of a cubic foot of brickwork as one cwt., the weight of one foot length of the wall works out to 26·25 cwt. But as this weight is distributed over an area of 300 square inches, the pressure of the wall due to its own weight is 0·09 cwt. per square inch.

Therefore $r_o = 0{\cdot}09 + 0{\cdot}25 = 0{\cdot}34$ cwt. per square inch, and the moment of resistance becomes

$$= \frac{16441{\cdot}75 \times 0{\cdot}34}{10{\cdot}85} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Equating (1) and (2)

$$1350\ P = \frac{16441{\cdot}75 \times 0{\cdot}34}{10{\cdot}85}$$

Whence P = 43 lb. nearly per square foot.

That is if the wall is built with the *best hydraulic lime* it becomes strong enough to resist a wind pressure of 43 lb. per square foot after 12 months, it being only strong enough to resist a wind pressure of 25 lb. per square foot when the mortar is fresh. As it is usual to allow a wind pressure of 50 lb. per square foot for ordinarily exposed situations, in an unexposed situation therefore, the wall might be safe enough but in an exceptionally exposed situation there is every chance of the wall being blown down in course of time.

If, however, the lower half of the wall is built with CEMENT $2\frac{1}{2} : 1$ proportion the mortar after 12 months having an adhesive strength of 0·34 cwt. per square inch, the wall becomes strong enough to resist a wind pressure of 54 lb. nearly per square foot and provides for ordinary conditions.

If it is desired to make the wall safe against wind pressure when the mortar is fresh, *neat cement* will have to be used.

THE KENNEDY V_o FORMULA.

I.

REFERENCE : the article under a similar heading in the issue dated 21st January 1928 of INDIAN ENGINEERING, and signed J. F.

The writer was unable to study the above article until the 30th March, mainly because the notation differed from his own, and he could not spare the time to master it.

Before proceeding further it is desirable to state Mr. Kennedy's position, in, as far as is possible, the actual words of his paper in Volume CXIX of the Civil Engineers :—

(*a*) The channels had assumed permanent sections by silting or scouring.

(*b*) The channel beds had silted, often 2 feet or 3 feet deep, deposited during many years of steady flow. No silt was ever cleared away ; and [at the period of the observations] the velocities just carried the sediment brought down.

(*c*) The sections arrived at were nearly rectangular, the sides being vertical. [Note the qualification "nearly."]

(*d*) [Read (*a*) and (*b*) qualified as below.] During variations in supply, the thickness of the silted bed was found to vary slightly through a few inches. [In other words, there was, see (*g*), alternate deposit and re-scour.]

(*e*) The mean velocity of the stream at each reach was derived from the known "full supply" discharge and the measured cross-sectional area of the channel.

(*f*) In the above estimate, losses by percolation and absorption were apparently neglected.

(*g*) In summer, silt was deposited chiefly in the upper reaches in which the velocities of the stream were least, and picked up again and carried forward by cold weather pure water. As a consequence, the streams were "about equally turbid all the year round." [See (*d*).]

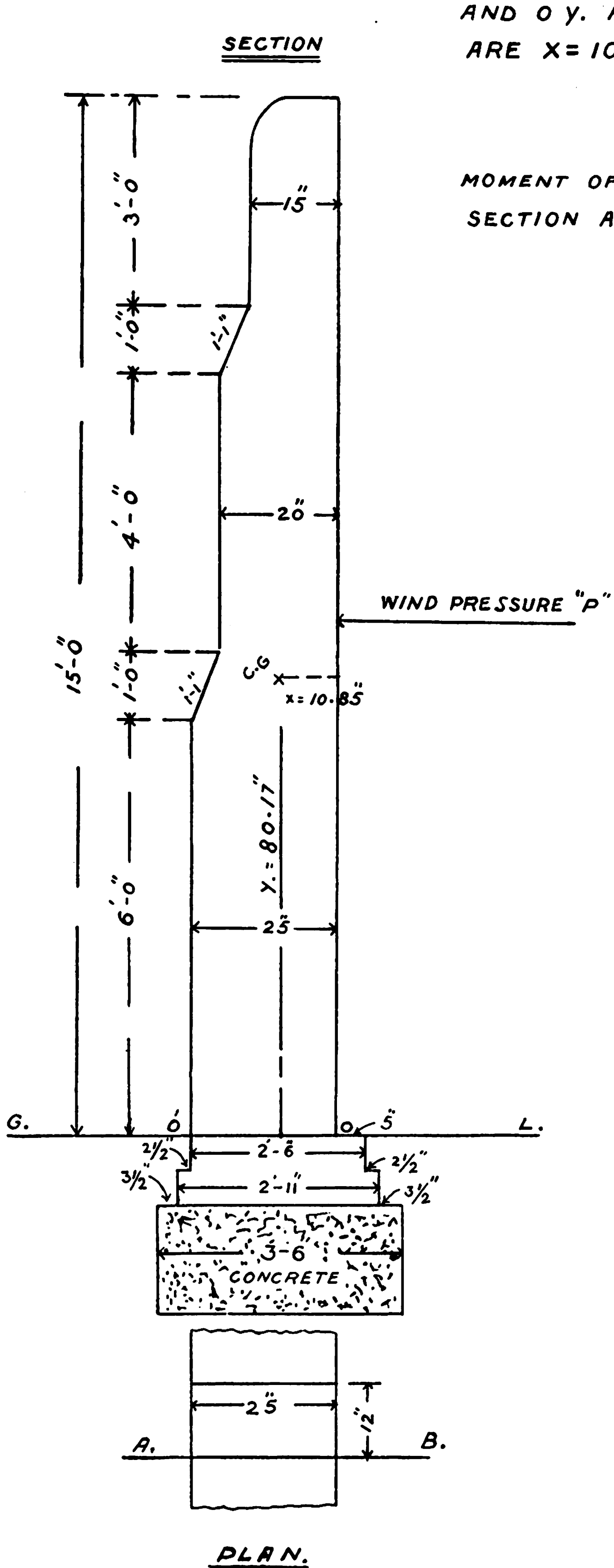
It seems perfectly plain to the writer, that Kennedy was given the opportunity of observing naturally adjusted channels, with natural V_o. It is therefore of supreme importance to determine the extent to which he was able to avail himself of the opportunity, and the limits of accuracy of his measurements and estimates of V_o. The turbidity of the streams, "about equally turbid all the year round," could not have permitted of any visual inspection of the exact shape of the sections ; and these could only have been determined by depth rods, sinking perhaps undetected in surface mud by an inch or two.* A further possible

* The sides were softer than the beds, and errors in determining the vertical nature of the sides more probable.

SECTION OF CENTRAL JAIL WALL. (CALCUTTA)
SCALE TWO FEET TO AN INCH.

THE CO-ORDINATES OF THE CENTRE OF GRAVITY OF THE SECTION TAKING OG. AND OY. AS THE AXES OF CO-ORDINATES ARE X = 10·85" Y = 80·17"

MOMENT OF INERTIA OF THE HORIZONTAL SECTION AT OO' = 16441·75



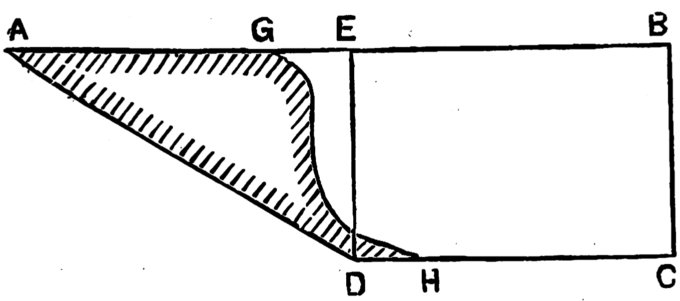
STRENGTH OF LONG WALLS.

source of error lay in the determination of mean velocities by possibly over-estimated discharges. Kennedy, a very experienced engineer, no doubt took every precaution; but small and separated errors can be accumulative, and not balanced. And, again, in some reaches, it is more than probable that slight silting or scouring was occurring while the observation was actually being made; too slight to be noticed, but sufficient to affect V_0 in the second decimal place.

[It is therefore very much to be desired that, if J. F. or anybody else possesses special information on these points, he should publish the same. An undeniable error in observation, provided that its $\pm$ limits can be determined, may actually lead to a more definite conclusion; and it would at the worst establish the difficulties in accurate observation, *and in no way discredit Kennedy.*]

The writer would diffidently urge that in his opinion, if the observed V_0 could be in some way checked and corrected to remove objection (f), all the other data might be accepted as substantially correct. It is surely not impracticable, with their present knowledge, for canal engineers to apply a correction which was, perhaps, not so easy of application in Kennedy's time? The result would probably be merely a correction in the values of Kennedy's constant and of the Pyramid C_0.

As regards the sections, the method of the Pyramid is explained by the following figure.



The above is the usual pyramid half-section of construction (and design), in which DC is half the bed-width (b), BC is the depth d, and AE (for the side-slope) $= \frac{5}{3}\,d$, or nearly a 30° side-slope. By the application of a suitable constant C_0 (see the P. K. Formula) the side-slopes were expected to adjust themselves, with a slight change (not scour) in the bed, and by silting, so that the hydraulic mean radius of the ultimate section, which would neither silt further nor scour, would become :—

$$\frac{3\,b/d + 5}{3\,b/d + 12} \times d$$

This value is, of course,

$$= \left(\frac{V_0}{C_0}\right)^2$$

[The slope or inclination which creates V_0 must be adjusted accordingly; as J. F. remarks for his own estimate of the hydraulic mean radius.]

Now, if in the ultimate channel, the area is $(b + t)\,d$ and the wetted perimeter is $b + \frac{7}{3}\,d$, with the same value for the hydraulic mean radius :—

$$\frac{b + t}{b + \frac{7}{3}\,d} = \frac{3\,b/d + 5}{3\,b/d + 12}$$

$$= \frac{3\,b + 5\,d}{3\,b + 12\,d}\,.$$

Whence :—

$$t = \frac{35\,d^2}{9\,(b + 4\,d)}.$$

The writer conceives the semi-section to be shown by something like the roughly curved line GHC on the figure, the section being "nearly" rectangular and the sides reasonably to be described as "vertical." And he respectfully submits that this section is what Kennedy actually observed and endeavoured to portray.†

The final discharge would be that due to V_0 and the area which is $(b + t)\,d$; and it seems clear that correct adjustments with that area of l, C_0, and naturally V_0, would lead to a correct discharge according to plan.

J. F. appears with 5 : 3 slopes to make his final hydraulic mean radius =

$$\frac{3\,b/d + 5}{3\,b/d + 11} \times d.$$

If this is a mistake, perhaps he will kindly state its true value in the above form?

Σ. Φ.

18th April 1928.

† Kennedy's B was probably $= b + t$.

QUASI-ARC ELECTRIC WELDING USED FOR MARINE ENGINE CROSSHEAD CONSTRUCTION.

THE wide application and adaptability of "Quasi-Arc" electrodes in shipyards is often brought out in a striking manner on occasions when it is found necessary to carry out important repairs at a moment's notice without the usual facilities for conducting the work. A good example of this is portrayed in the following account received from Australasia.

A 12,000-ton liner arrived at a small isolated port where it was held up through engine trouble. On examination it was ascertained that the journal of the main engine crosshead had fractured at the neck necessitating the construction of a new crosshead.

The usual methods for carrying out such work necessitating heavy forging, could not be employed as steam hammers were not available. Quasi-Arc representatives were called in therefore to tackle the problem which was solved by welding two 12" × 12" × 6" steel blocks to a length of 11" diameter shafting. The whole was then machined and planed to size resulting in a first class piece of work to the satisfaction of all concerned.

Approximately 1,400 feet of No. 8 and 200 feet of No. 10 "Quasi-Arc" mild steel electrodes were consumed and the work was completed in 50 hours without stop, which was less than half the time that would have been taken had the usual methods of construction been employed. This in itself was most important as the ship had been delayed badly by the accident.

Messrs. Turner, Morrison and Company, Limited, Calcutta and Bombay, handle Quasi-Arc products in India and Ceylon.

THE PROGRESS OF AVIATION.
A CURRENT RECORD OF EVENTS.

LONDON, *25th April 1928.*

A TRIUMPH OF BRITISH AIRCRAFT DESIGN.

AN event of more than ordinary interest in the world of Aviation was the first flight of the Beardmore-built "Inflexible" all-metal monoplane at Martlesham Heath. This giant machine is the largest all-metal monoplane in the world and is undoubtedly a very fine achievement on the part of its designers and builders.

The wing span of the "Inflexible" is no less than 150 feet, so that it is considerably bigger than its nearest competitor in span, the French Penhoet flying boat, which is 131 feet. The rectangular fuselage in the cabin section is about 12 feet deep and the landing wheels stand 7 feet 6 inches high. At least 20 passengers will be carried. Only by such figures is it possible to get an approximate idea of the dimensions of this huge machine.

Three Rolls-Royce Condor engines of 650 h.-p. each are fitted, one mounted in the nose and one on each side of the fuselage. Brakes are incorporated in the landing wheels and are automatically applied

when the tail is dropped on landing, so that the machine can be pulled up in a remarkably short distance from the first point of contact. It is believed that in the air just over one-third of the total horse-power only is needed to maintain level flight.

A New Rolls-Royce Engine.

Mention of the Rolls-Royce engines calls to mind the interest displayed by King Amanullah of Afghanistan in the aero engine department of the famous Derby works when he was recently in England.

There he was shown one of the latest aero engines designed by Mr. Henry Royce to fulfil the special requirements of the Air Ministry for use in the most up-to-date types of aircraft employed by the Royal Air Force. Few details are yet available of this engine but it is known to be of over 500 h.-p. with a bore of 5 inches and a stroke of 5½ inches. Special attention has been paid to keeping down external dimensions.

A True Ship of the Skies.

Successful tests have been carried out at Friedrichshafen with a giant all-metal flying boat which, although of foreign construction, employs British engines. This is a Dornier-Napier machine which has accommodation for 20 passengers in two comfortable cabins. Twelve passengers occupy the front cabin and eight the rear one, while there is a through gangway connecting the two.

This flying boat is built on ship lines, being fitted with watertight bulkheads so that any section of the hull can be completely shut off in the event of damage by flooding. From the hull to the wings where the engines are mounted is an enclosed conning tower with ladder, so that the mechanic can reach the engines and inspect the instruments during flight. Incidentally, all the instruments are electrically operated, and, should the water or oil temperature not be correct, a light appears drawing the pilot's attention to the fact.

Of particular interest to British flying enthusiasts is the employment of the well known Napier engines in this very up-to-date machine; four are fitted developing 2,000 h.-p. and enabling the craft to cruise at 105 m. p. h. with a top speed of 135 m. p. h. The official full load is 12,000 kilograms, although as much as 14,000 kilograms has been successfully taken.

A Very Difficult Air Route.

It is certainly very satisfactory to find British engines being employed increasingly by foreign air lines. A case in point is the Milan-Munich service, which the Avio Linee Italiane S. A. of Rome is inaugurating with a fleet of Armstrong Siddeley Lynx-engined Fokker monoplanes. This is probably the most picturesque and difficult air line in the world, for it commences and ends with but a few miles of level country and then rises to a height of 12-15,000 feet in order to clear the Alps.

Milan is only 900 feet above sea level, and machines going north have only a few miles over the Italian plains is which to gain height. After passing over Monza, the famous motor racing track, the easterly end of Lake Como comes into sight. In front are the Berganese Alps with Mt. Redorta nearly 10,000 feet high. The town of Sondrio is the next landmark on the journey, after which comes the Bernina Pass between St. Moritz and Tirano. After passing the Ortler, nearly 12,000 feet, the scenery becomes less wild and the final stage towards the Bavarian border and on to Munich is comparatively easy.

The run south is not so difficult, of course, because Munich itself is 3,000 feet above sea level and the mountains do not rise as abruptly as on the Italian side.

Japan Buys British Aircraft.

It is good news to learn that the Imperial Japanese Navy has recently placed an order with the Supermarine Aviation works for one of their "Southampton" twin-engined flying boats.

This machine has a hull of metal construction, and is similar to the R. A. F. flying boats now engaged on the long cruise to Australia and the Far East. If the trials in Japan are satisfactory, it is understood that further orders will be placed. The Supermarine "Southampton" is, of course, fitted with two Napier Lion engines.

MECHANICAL SAND WASHING.

LATEST DESIGNS OF THE "PEEBLES" PORTABLE MACHINE.

It may be remembered that we have given in these columns a description of the "Peebles" patent sand washing machine, which was introduced about five years ago, by Messrs. Glenfield and Kennedy, Ltd., of Kilmarnock, Scotland, and which enables dirty sand from filter beds to be washed mechanically with very low water pressure.

This, of course, constitutes, as is well known, a remarkable advance as compared with the old method of cleaning the sand by means of a tank, with the sand and water stirred or agitated by hand, and it may be stated that over 70 of these "Peebles" machines are now at work. In India, some of the installations are at Allahabad, Agra, Benares, Calcutta, Lucknow, Muktesar, and Rangoon, while they have been supplied to almost every country in the world, including, in the Far East, both China and Japan.

We are now able to give particulars of the latest design of "Peebles" patent sand washer of the portable and stationary types, suitable for a capacity of 4 tons of sand per hour, those being on the same general lines as the previous machines except that now only one chamber, fitted with the necessary dividing plates is required, instead of three separate chambers as before, being applicable to both the fixed and the portable type. In the latter case the machine is wheeled about from one sand bed to another as required.

In general, with both types of the new machine and water, say 7/10 lb. pressure, the capacity is approximately 4 tons of sand per hour, with a consumption of about 2,000 gallons of water in this time. Also the stationary machine weighs 14 cwt., and the portable type 17 cwt.

Messrs. Glenfield and Kennedy, Ltd., have also recently placed on the market another new and very powerful triple jet machine of the fixed type, which weighs 31 cwt., notable examples being installations for the Liverpool, and also for the Bradford Corporation Waterworks. In this particular machine, the capacity is a minimum of 12 tons of dirty sand per hour, and from that up to 15 tons, when supplied with water at about 10 lb. per square inch pressure, together with a very small extra quantity of water at 40 lb. per square inch, for operating a water motor which drives the oscillating screen device for the entering sand.

To-day a range of machines are available to suit different conditions, and as already indicated a characteristic feature of the designs is the use of a low water pressure, this being 7/10 lb. for the 4-ton machine, and 10/25 lb. for the 12-ton machine.

The principle is that the dirty sand first passes through a screen to remove pebbles and other *débris*, and then falls into the water tank, where it meets a series of powerful jets of water. As a result of the intimate mixing of the sand with this water and the upward rush of the latter, the dirt and impurities—which are lighter—are washed out immediately, and overflow to a dirty water discharge, while the heavy sand sinks again by gravity to the bottom of the apparatus and is then discharged in a continuous stream of clean sand and water. Apart from gravity, the action is also aided very considerably by the rubbing of one grain of sand upon another, due to the rapid change in direction within the machine, and obviously the ordinary hand methods of cleaning filter bed sand are now obsolete.

THE REVOLUTION IN PHYSICS.*

BY SIR OLIVER LODGE.

THE nineteenth century came to a climax, as far as physics is concerned, in the discovery of the discontinuous nature of electricity and the isolation of the electron. It turned out to be a natural unit of electric charge, of specified size and mass, and with a measurable momentum and energy when propelled by a given drop in voltage. The same electric units were obtained from every kind of atom, irrespective of its chemical nature; and they were proved by Zeeman to be the particles which generated radiation. Their impacts when suddenly stopped in a vacuum tube were indeed found to generate a new kind of radiation called X-rays. Their whole mass corresponded with an electric charge of a given size, in accordance with the theory formulated by Sir J. J. Thomson so long ago as 1881. They had no matter associated with them, and at very high speeds their mass increased with the speed, in a way which was calculated from purely electric principles by both Oliver Heaviside and Sir J. J. Thomson. In fact, a great deal seemed known about them.

Some of this knowledge remains valid; but the twentieth century has so far succeeded in putting everything back into the melting pot, and reducing the electron itself to a curious state of uncertainty, an uncertainty which always existed as to its nature and constitution. Electrons may still be treated as structures in the ether, of an unknown kind; but no longer can their size and shape be specified with the same certainty as seemed legitimate at the beginning of the century. The way they produce energy has been worked out in great detail by Bohr on the assumption of unexplained quantised orbits, in which they can remain stable without radiation, but from which they cannot jump without emitting radiation, of a perfectly definite kind, which can be predicted arithmetically and accurately verified by spectrum analysis.

Very little of this was known to Lord Kelvin, who died in 1906; and probably no suspicion of it had dawned on Clerk Maxwell, who had died some years before. I doubt if even FitzGerald grasped the consequences which have followed from the discovery of this curious discontinuity in electricity. And now some uncertainty has entered into our views as to the constitution of the electron itself; and Schrödinger adduces evidence to show that they are not so much like particles or corpuscles as like a train of waves. The simplicity of the wave theory of light has been complicated into a kind of corpuscular theory by the quantum; while at the same time the corpuscles themselves are being resolved into waves. All this is very puzzling, and at the same time very interesting; and for the complete solution the present generation will have to wait.

Meanwhile, and temporarily, the Ether of Space has suffered from the same kind of doubt. It is argued that if radiation is something shot out in quanta, it may be shot out into perfectly empty space, and that the need for an etherial vehicle of communication has disappeared. I do not agree, for a great many reasons. But all theories are being overhauled, and the end is not yet.

Lord Kelvin would have been no doubt keenly interested, and would also have been very much perturbed, by the present state of physics, which is full of hypotheses that would have seemed to him wild, and which certainly are of a revolutionary character. The mathematical methods employed are of a novel and undynamical kind, very different from the methods which dominated the nineteenth century and were so successful in dealing with the then known properties of matter. With the ether, however, those methods did not satisfactorily deal. Something apparently inexplicable intervened, directly the ether was brought into notice. There was a puzzle as to how ether and matter interacted as well as about a possible constitution for the ether itself. Both Lord Kelvin and G. F. FitzGerald made many attempts at a dynamical ether; that is to say, they sought to explain the properties of the universal medium in terms of mechanism, constructing or imagining mechanical models which would have something the same sort of properties, and would give or suggest a possible constitution for an electro-magnetic medium. They aimed at thus explaining the phenomena of electricity, magnetism, and light, though they did not attempt to introduce gravitation into their scheme, and on the whole they failed. The ether regarded as an elastic solid had a long day, and at one time promised well, but sooner or later it always collapsed. Its contradictory properties could only be reconciled by special pleading; and at length we all came reluctantly to the conclusion that the ether could not be explained in terms of mechanism. We began to think that the laws of dynamics would not apply to it. Newtonian laws were sufficient for ordinary matter, but even here they could hardly be extended to cover special cases, when extreme velocities, or even extremely low temperatures, were encountered. Discontinuities began to make their appearance, not only in electrical phenomena and in radiation, but even in matter itself near the absolute zero of temperature. Mechanical theories of the ether had to be abandoned; and this is what is meant, or should be meant, by the statement that "the ether no longer exists." The arguments for an ether of some kind are as valid now as they ever were; and Einstein himself has devoted three lectures in a little volume, entitled "Sidelights on Relativity," to claim the physical necessity of an ether, in order to enable the new equations to be interpreted in physical terms. The characteristic constant of the modern ether is the constitutional velocity c, which is the same order of magnitude as the velocity of light; and that constant c dominates the present situation.

In trying to expound in some elementary fashion some salient features of the present position, I shall aim at being as conservative as I can. I shall not attempt to enter upon the most recent forms of wave theory, but shall limit myself to views which have instinctively commended themselves to me, and, what is more important, commended themselves also to some extent to that great man who has recently parted from us, H. A. Lorentz. They have also received attention and been partly elaborated in detail by Poincaré and Langevin. I think it highly unlikely that my hypothesis about the structure of an electron is anything like finally correct; but sometimes a position may be helpful as a stepping-stone, although it has soon to be discarded. And it may be worth while to make some statements about the ether and about the possible structure of an electron, even in face of the hostile criticism which they will doubtless encounter, and the contention that they are already superseded.

In addressing an assembly of electrical engineers, I would remind you that electrons are what this Institution specially deals with. In one form or another they are what you harness, drive, and utilise, and it is only natural to wish to know what sort of things they are. You have had these active little creatures harnessed for some time, and have propelled many things by their aid, from telegraphic messages to railway trains. But you have never been allowed to see them, even metaphorically. They are cloaked; so that we are like a costermonger with a shrouded animal between his shafts, who does not know whether it is a dog, a zebra, or a donkey. He can only infer its nature from its more or less tractable behaviour. And certainly electrons have proved themselves not only very active, but very tractable, very obedient to the smallest guidance, and yet very energetic. We can readily drive them along wires, but then we cannot count them, and do not know at

* Abstract of Kelvin Lecture delivered before the Institution of Electrical Engineers, from "The Engineer," 20th April 1928.

what pace they go. It is rather odd that even now we have something less than full and complete knowledge of all that happens when you press the button of an electric bell.

The first mode of propelling them, devised at the beginning of last century, was to coax charged atoms to move through a liquid by a differential chemical attraction; that is, by the greater attraction of zinc for oxygen than was possessed by copper or carbon. The charges were thus conveyed through the liquid, and delivered up to the electrodes at either end, whence they went of their own accord through the wire joining the plates, with an energy derived from the chemical action, which thus took the primary form of an electric current, instead of heat.

Then Faraday made the extraordinarily fruitful discovery that they could be propelled by moving a magnetic field near the wire of a metallic circuit, a method which soon eclipsed the older method in power, and made heavy engineering possible. This, however, was almost a more blindfold method than the older chemical one; for now the atoms did not move, in any part of the circuit; they seemed to pass the electrons from hand to hand, whereas in the liquid part of a telegraphic circuit electrons clung tenaciously each to their own atoms, and were conveyed by the atoms or carried the atoms along with them. Only in a vacuum were we able to shoot them off from a metal, and get them to travel on their own account, divorced from any form of matter—as was first emphasised by Sir William Crookes—in such a way that their speed and other peculiarities ultimately yielded to the penetrating insight of Sir J. J. Thomson and his co-workers.

Then it was found by Hertz and Lenard that it was possible to shoot them out into the open air; while Becquerel made the important discovery that the atoms of certain heavy substances shot them out on their own account without any stimulus. At the same time an experiment, first made by Guthrie, and then developed extensively by Professor Richardson, showed that they evaporated freely from hot metals, and were subject to control, as in the familiar vacuum valves of to-day.

It was also found that high-frequency radiation was able to expel electrons from certain substances, with an energy exactly proportional to the vibration frequency of the light or other radiation which expelled them; though why this proportionality should exist between energy and frequency in all cases and for all substances, as was finally demonstrated by Max Planck, I doubt if anyone is fully prepared to say. There is evidently something deep-seated in atomic structure here, which when properly understood will account for this relation, and for the reciprocal fact that the speed or energy of a flying electron determines the frequency of the light which it emits when stopped. Meanwhile, the study of radiation, or the interaction between matter and ether, has resulted in the discovery of the quantum that remarkable natural constant, which bids fair to revolutionise the whole of physics, and in due time must undoubtedly throw light on the connection between ether and matter. Suffice it to say here, in the words of Professor Whittaker, expounding the view of H. A. Lorentz, with which in all major respects I agree:—

"The essential characteristics of Lorentz's theory were that all electric, magnetic, and optical phenomena were supposed to be due to the presence or motion of individual electric charges, constituting the link between ponderable matter on one hand and the ether on the other. Matter and ether were supposed not to interact directly, and to be capable of influencing each other only through the mediation of electrons; moreover, the electrons were assumed not to interact directly (as they had been supposed to do in the older electron theories), and to be capable of influencing each other only through the mediation of the ether. The ether itself was conceived to be at rest everywhere and at all times, whereas in the earlier theories it had been regarded as entangled with the particles of bodies, and carried along with these when they move. Lorentz's ether was, in fact, merely space endowed with certain properties. The general plan of the investigation was to reduce all the complicated cases of electric and magnetic action, *e.g.*, the properties of dielectrics, metallic conduction, metallic reflection, the Hall effects, etc., to one simple and fundamental case, in which the field contained only free ether with electrons at rest or moving in it."*

(To be continued.)

The Gazettes.

Punjab, May 4, 1928.

Irrigation Branch.

Lala Nand Gopal, officiating Executive Engineer, on transfer from the Balloki Division, Lower Bari Doab Canal, which he left on 20th March 1928, took over charge of the Chenab Drainage Division, Waterlogging Investigation Circle, on the same date.

Lala Ishar Dass, Assistant Engineer, attached to the Bikaner Main Line Division, Bikaner Circle, Sutlej Valley Project, is allowed leave on average pay (privilege leave) for 6 months, and in continuation leave on average pay on medical certificate for 2 months, with effect from 22nd November 1927.

Mr. C. A. Munro, who has been appointed as Inspector of Draglines, landed at Bombay on 29th March 1928, and joined the Upper Chenab Canal Circle on 2nd April 1928.

Sardar Bahadur Sardar Prabh Singh, Executive Engineer, on transfer from the Punjab Irrigation Secretariat, which he left on 19th April 1928, took over charge of the 2nd British Circle, Sutlej Valley Project, on the same date, from Rai Bahadur Bhagwati Prasad, Varma, Superintending Engineer, transferred. Sardar Bahadur Sardar Prabh Singh has been appointed to officiate as Superintending Engineer, with effect from 20th April 1928.

Rai Bahadur Bhagwati Prasad, Varma, Superintending Engineer, on transfer from the 2nd British Circle, Sutlej Valley Project, which he left on 19th April 1928, took over charge of the office of Chief Engineer and Secretary to Government, Punjab, Public Works Department, Irrigation Branch (Southern Canals), from Mr. N. White, Chief Engineer, on the same date. Rai Bahadur Bhagwati Prasad, Varma, is appointed as Officiating Chief Engineer and Secretary to Government, Punjab, Public Works Department, Irrigation Branch, with effect from 20th April 1928.

Lala Sunder Das, Khangar, Assistant Executive Engineer, on transfer from the Chitwala Division, 3rd British Circle, Sutlej Valley Project, which he left on 4th April 1928, took over charge of the Qaimpur Division, 2nd Bahawalpur Circle, Sutlej Valley Project, on the 11th idem, from Mr. M. L. Lawson, Temporary Engineer, transferred.

Khan Sahib Khan Faqir Muhammad Khan, Executive Engineer, on transfer from the Hafizabad Division, Lower Chenab West Circle, which he left on 7th April 1928, took over charge of the Jhang Division, Lower Chenab West Circle, on the 17th idem, from Mr. A. Youngson, Assistant Engineer, transferred.

Mr. T. Blench, Assistant Executive Engineer, on transfer from the Majitha Division, Upper Bari Doab Canal, which he left on 29th March 1928, joined the Weir Division, 1st British Circle, Sutlej Valley Project, on the same date.

Mr. H. F. Ashton, Officiating Chief Engineer (Northern Canals), and Secretary to Government, Punjab, Public Works Department, Irrigation Branch, took over charge of the office of Chief Engineer (Construction), in addition to his own duties, on 11th April 1928, from Mr. R. P. Hadow, C. I. E., Chief Engineer, who proceeded on leave.

Lala Hans Raj, Anand, Assistant Engineer, attached to the Rohtak Division, Western Jumna Canal, took over charge of the Hissar Division, Western Jumna Canal, in addition to his own duties, on 16th April 1928, from Mian Muhammad Fakhr-ud-Din, Executive Engineer, transferred.

Bihar and Orissa, May 9, 1928.

Public Works Department.

Mr. W. A. Garson, Executive Engineer, is granted leave on average pay on medical certificate for six months and twenty-three days, with effect from 17th March 1928.

Irrigation Department.

Mr. Mohan Lal Bahl, Assistant Executive Engineer, is, on return from leave, attached to the office of the Superintending Engineer, Son Circle at Arrah.

* *Nature*, 25th February 1928, Vol. 121, p. 290.

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CONTENTS.

INDIAN ENGINEERING.

SATURDAY, MAY 26, 1928.

THE WATERWAY OF BRIDGES AND CRAIG'S FORMULA.

IT is not perhaps surprising that the article on the above subject by Mr. Farrant, which we published on 19th November last, should have met with some criticism, for the question in all its bearings presents a good many complications. But our non-mathematical engineer readers need not on that account regard such discussions as futile; whatever the science there is much that lies in the lap of the unknown and therefore there will inevitably be some differences in expert opinion; and it is only by patient investigation and discussion that we are enabled to see light through the difficulties confronting us. For that reason, we welcome the rejoinder by Mr. Farrant to the objections raised by our contributors, a "Correspondent" and Mr. Lillie, and draw the attention of our readers to it, with the following remarks. In a short table at the end of his first article, Correspondent compares the value of $f\left(=\frac{A}{\sqrt{M}}\right)$ and $\frac{3}{M^{\cdot 07}}$ in Mr. Farrant's deduction and, in the case of the Sohan river, gets the former just upon half the value of the latter by taking A or $\frac{S}{440}$ equal to 23, whereas Mr. Lillie's formula gives S=13500, or 35 per cent. greater, while Sir Alexander Taylor gives an area 42 per cent. greater, from which it appears that the comparison is not so unfavourable as Correspondent makes it seem. Moreover, an examination of the plan of this catchment (see diagram in Mr. Lillie's paper) shows that it is remarkably fan-shaped and compact and one from which a large flood-section might be expected. In his second article, Correspondent seems to us to have gone a little astray, for, as Mr. Farrant states in order to get the correct rate of discharge there must be a connexion between the volume discharged and the time in which it is discharged. Further, it is obvious that Craig did not regard the coefficient C very seriously as an important flood moderator; and this particular criticism by Correspondent therefore calls for no more than a passing comment. Correspondent's objection that B in Mr. Farrant's formula is twice Craig's B, and that "therefore J. F.'s values of A (area of flood section) are all too great" requires more notice. A solution of Craig's formula with B equal to the mean width of his illustrative triangle was given by Mr. Granville in INDIAN ENGINEERING of 21st April 1923, where it is shown that the numerical factor would be 880 in that case (instead of 440), and as 440 B equals $880 \times \frac{B}{2}$ it is clear that Mr. Farrant's flood areas on the whole are not too great, and that Correspondent's conclusion in the particular case of the Adjai is unsound. There are many inaccuracies and inconsistencies in Craig's formula, and this is one of them. We can only suppose that he took B to be the *extreme* width of his

illustrative triangle in his investigation, although it appears as the *mean* width in his final result.

Mr. Farrant now explains more fully how Craig's original assumptions as to i and v, when other errors in the development of this idea are brushed aside, amount to this—*that the contribution of an element of his illustrative triangle to the flood section at outfall is proportional to the width* b *of that element.* This is practically the same as Mr. Lillie's fundamental principle. Known cases lend support to Craig's assumption, and show that there is the germ of truth in it. It is on this basis that Mr. Farrant derived his formula, taking a catchment of *average* length or $L=2\sqrt{M}$, L being supposed to be the length as measured along the main channel and not the radial length employed by Mr. Lillie. This brings us to Mr. Lillie's comments in our issue of 18th February last, from which we quote the following passage: "But how does Mr. Farrant arrive at his formula? He proceeds as follows:—he accepts Craig's original assumption and like Craig makes no attempt either to explain or justify the same; then from this assumption he produces the formula by simple mathematical deduction, a most dangerous process that nearly always comes to grief." From this and what follows, it seems evident that Mr. Lillie has formed a wrong conception of Craig's original assumption, which is that given above in italics, or, as Mr. Farrant puts it in mathematical form, Craig's assumption is that "the contribution to the peak discharge is 440 vi cusecs *per mile of width.*" The erroneous log factor in Craig's formula is transformed by Mr. Farrant into $\frac{3}{M^{.07}}$, a factor which diminishes as the area of catchment increases; Mr. Lillie on the contrary derives his *size* factor from it, a factor which increases with L and is unity when L is 20 or less, showing an entirely opposite conception of the use of this log factor. Mr. Lillie proceeds in his article to say: "Of course the mistake in Craig's assumption lies in taking i as the *quantity* of water falling during the rain-storm instead of the intensity ....," and develops the expression $K\int\frac{i\,d\,w}{y}$ for the rate of discharge from the whole catchment, whereas Mr. Farrant states that $\frac{i\,d\,w}{y}$ is an *area* rate, not a discharge rate, and suggests the assumption straightaway that the flood section is proportionate to the width instead of approaching the solution by way of the discharge. He shows, we think conclusively, that the reducing factor $\left(\frac{K}{y}\right)$ depends upon the absorption and not upon the *distance* of the element of area from the outfall, this being an index of the time taken by the element to "feed in." Lastly, Mr. Lillie holds that "a formula giving S as a function of M_a alone cannot even remotely approach reliability," and he "cannot share Mr. Farrant's opinion that my figures for the bridges on the Ondal-Sainthia Chord Railway are too small, not even in the case of the Adjai."

The above, it is hoped, focusses the position of this particular discussion to some extent, and readers cannot fail to be interested as the subject is closely allied to that of the flood discharge from catchment areas, and railway engineers especially now have the opportunity of comparing the two formulæ. They both start from practically the same foundation, and Mr. Lillie works on the aggregate length of sectorial arcs, $\Sigma(\theta\,L)$, while Mr. Farrant takes the extreme width (B) of an equivalent isosceles triangle, and it will be found that the former generally exceeds B. Mr. Lillie, further, introduces a rainfall factor (R), which has the value fixed at 4 for catchments between 3 and 15 square miles (about), and for larger areas varies from 4 to 6. This occurs to us as a weak link in the chain, as floods in small catchments are due chiefly to heavy sporadic rain-storms which have no established connexion with the annual rainfall. In dry tracts the whole of the annual rainfall may come down in a few days. In the case of perennial rivers it is different, as the ground-water depends entirely on the annual precipitation (snow or rain). Further, in the case of small catchments ($L = 20$ and $M = 100$, say) the size factor (λ) is also reduced to unity, with the result that areas obtained from Mr. Lillie's equation, $S = R\,\lambda\,\Sigma\,(\theta\,L)$, appear to us to err in defect, though Mr. Lillie maintains that they do not. Further investigations on this point would be very valuable, particularly information of the kind contained in Mr. Buyer's report on the waterway of the bridges on the Ondal-Sainthia Chord Railway, and we hope that our readers will allow up to make an appeal to them for such investigations in order that the doubtful points in the controversy may be elucidated.

STRANGE ON RESERVOIRS.*

When Mr. W. L. Strange, an engineer on the Bombay establishment, decided to offer a paper on "Reservoirs with High Earthen Dams in Western India" to the Institution of Civil Engineers, he probably little guessed how great would be the success that was to attend his studies of this particular subject. The paper won him the Telford Premium of the Institution, and encouraged by the reception the paper met he proceeded to extend the treatment of the same subject in book form, with the title "Indian Storage Reservoirs with Earthen Dams," which was published in 1904. By that time, Mr. Strange had still more encouragement than that afforded by the Telford Premium with which he had been presented, for he had foreseen from the investigations of the Indian Irrigation Commission of 1901-03 that attention was likely to be turned to the construction of storage reservoirs in some parts of India. In his preface to the 1904 edition, dated April 1903, he said: "It is probable that one of the first results of the inquiries made by the Indian Irrigation Commission

* Indian Storage Reservoirs with Earthen Dams, being a practical treatise on their Design and Construction, by William Lumisden Strange, M. Inst. C. E., Third and Enlarged Edition. London: George Routledge and Sons, Ltd., Broadway House, 68-74, Carter Lane, E. C. Price 25s.

will be the construction of storage reservoirs to serve parts of the country which are peculiarly liable to drought. * * * Seeing that but few works of this class have been constructed anywhere in recent years, and that now they are being commenced for the first time in certain provinces, it occurred to me that a book treating of the different problems which present themselves, both in the design and in the construction of storage reservoirs, would be of use as a guide to those entrusted with their execution."

Mr. Strange was perfectly right in his forecast that in the circumstances of the time his book would be required, it was required and it was required as soon as it was issued. Rarely, if ever, has any Commission been the equal of the Irrigation Commission in the excellence of its judgment and of its recommendations. Lord Curzon, moreover, who had called the Commission into being, was enthusiastic, irrigation was one of the subjects in which he took a special interest, and no sooner was the report made public than the provinces were eager to avail themselves of the funds in store for them. But with all the eagerness displayed, the larger and more costly projects took time to prepare, the smaller tank irrigation schemes took much less time and were first in the field. Some of them had been prepared or were under preparation when Mr. Strange's book appeared, and then the engineers found that they had to some extent been faulty in their designs. Even so great an engineer as Sir John Benton was forced to admit that the work was both eminently practical and sound in its principles, and that it was valuable in correcting some previous mistakes, it therefore met with a cordial welcome in consequence of the need for it. In the Central Provinces and elsewhere, wherever such schemes were taking shape, the book was accepted as a reliable guide. Mr. Strange had, in fact, made a decided hit in his first venture in professional authorship.

Technical engineering works are not, however, in the same category as best-sellers in the form of novels or of books that contain the inner history of stirring events by people of celebrity in the world. Their sale is comparatively slow, and a book on irrigation, and only on one particular item of the irrigation subject, has not too comprehensive an audience. It consequently says a good deal for the book in question that it should have continued to be in demand and that in nine years a second edition should have been in requisition. The second edition appeared in 1914, and in it the original text was thoroughly revised and amplified with the painstaking care Mr. Strange devoted to any labour he undertook. With that issue the sale still continued, showing that the book in spite of the small public appertaining to it remained in request, and it is a matter of congratulation to the author that in 1928 a third edition should have been found to be necessary. The third edition which is now available is a considerable improvement on the two previous issues, and the author has evidently given much thought to it to render it in every way up to date. The preliminary chapter, the five succeeding chapters, and the appendices have all been enlarged, and there are more figures in the text, more plates and more appendices. The number of pages is now 506 against 364 of the first edition. Chapter I deals with the reservoir, in its relation to catchment area, rainfall and run-off, storage capacity, silting, survey, and other considerations. Chapter II is concerned with the design of dam embankments, materials, puddle trench, drainage, foundations, pitching and earthwork slips. Chapter III is on all matters in connexion with the waste-weir, its different forms and calculations, the tail channel and the flood-absorptive capacity of reservoirs. Chapter IV deals with the outlet, regulating works, and valves and sluices. Chapter V gives much miscellaneous information regarding water-supply schemes, plant, maintenance, the report, plans, estimates and specifications. There is no point that has been overlooked, the book is a very complete compendium of all that is necessary for the engineer from first to last, and we know of no other work which is so lucid and so dependable in all its particulars as a guide to engineers having to design and execute engineering schemes of this class. It can be very confidently recommended as a very valuable work of reference.

THE SARACENIC INTERLUDE.

THE special object of "A Short Critical History of Architecture" by H. Heathcote Statham, F. R. I. B. A., is—as the author states it—to give a concise history of the development of architectural forms and styles in such a manner as to render it not a mere statement of facts in chronological order, but a critical commentary on the merits and weaknesses of the various styles and buildings described, thus inviting the reader to consider what are the influences, and what the treatment of design, which go to produce good or bad architecture, on the principle that the history of an art should at the same time be a lesson in the art. In that aim Mr. Statham has acquitted himself so well that his book can be confidently recommended to architectural students. In his scheme he treats in turn with architecture before the great Greek period; Greece and Rome, the great columbar styles; domed styles and the Byzantine type; Romanesque to Gothic; the Saracenic interlude; the Gothic period; and lastly from the Renaissance to modern times. All these chapters are interesting, but at the moment it is proposed to concern ourselves solely with that appertaining to the Saracenic as of special interest to us in India. Mr. Statham calls it an "interlude" and not without reason. It does not spring out of other styles, or pass on to other styles in the ordinary course of evolution, it is just what it is called an interlude. Hindu architecture, although mentioned, finds no definite place in the treatise, and that too is not without reason. When the Hindus began to build in masonry they could hardly ever forget that they were not building in wood; and when from their rock-cut temples they proceeded to build in the open they followed their rock traditions and built great masses

of masonry into which they could carve a multiplicity of ornament as they had previously done in rock. Their sculpture was of such wonderful dexterity that it will always be one of the marvels of the world, but deprived of the beautiful sculpture the buildings possess nothing worthy of the name of architecture. Hindus contributed to architecture the bracket capital which, as a means of shortening the span of the architrave, is a good constructive motive; but outside that, generally speaking, Hindu architecture plays little or no part in the development of architecture as an art. There is much in it that is picturesque, but nothing of composition, proportion or restraint.

The history of Saracenic architecture is, however, intensely fascinating. The style followed the Mohammedan religion and the Mohammedan conquest, but it sprung from no traditions. The first mosque at Medina was a courtyard roofed with palm branches covered with plaster and supported by tree trunks, a very humble structure. The Arabs were a rude people, the nomadic Bedouins lived in tents, the buildings in towns like Mecca and Medina were of a very primitive character, mud walls roofed with palm leaves. A mosque is not, like the Greek temple, erected in honour of a deity, it is erected as a shelter for worshippers, as a place of prayer and of temporary seclusion from the outer world. The first mosque, humble as it was, sufficed for that purpose. But if the Arabs had at first no idea of art in their wild surroundings, they carried in the early centuries of Islam their invasions far and wide, and conquering and forcibly converting peoples of higher civilisation they employed the builders of the countries they annexed to build to a style that came to be known as the Saracenic. The Arabs may have had little or no knowledge of architecture, but the peoples they conquered had, and they had their own ideas, but the character of the buildings was dictated by the conquerors and so there arose the style which was adopted by all followers of the Prophet. The Arabs were not like the Romans who carried their own architectural style with them wherever they went, they had no style to carry; but they dictated what they held to be essentials, a typical plan, a certain orientation and other features, and the builders of the countries they overran did the rest. For that reason the style differed in degree in different countries and yet was always the same.

As examples of what it is intended to convey, the happenings in some of the conquered countries may be stated. The initial creed of Mohammed, as said by Mr. Statham, might have adopted for its own the Pauline utterance that "the Most High dwelleth not in temples made with hands." The first mosque was a very crude affair, and there was no thought at that time of beautiful architecture. The plan at Medina became the standard plan for the mosque wherever erected, and it was only after the great military successes of the Arabian arms that there was any ambition for costly buildings, entirely at variance with the stern simplicity of the original programme. In Egypt, at the conquest, the Arabs employed the Coptic builders, and these builders had been using the two-centred pointed arch in Coptic churches. They continued the use of this arch in Saracenic architecture, and the Arabs did not mind that. They would have objected to many things, to graven images, for instance, as an abomination; but there was no objection to the pointed arch, and it came to be considered a Saracenic arch. Then as the conquest extended to Morocco and to Spain the horse-shoe arch came into evidence in mosques, and it was rampant in the great Cordova mosque, the centre of Spanish Islam. The Arabs did not invent it any more than they invented the pointed arch, they merely allowed the builders they employed to use it. When they conquered Persia, they found there the indigenous Sassanian style, and that style had its influence. In Persian Saracenic the horse-shoe arch never enters, there was either the pointed arch or more usually the four-centred. The Persian Saracenic has a special point of interest because it worked westward to Turkey and eastward to India, and in India it came to be called the Indo-Saracenic because although the style was derived from Persia the Hindu builders had an influence on it. The earlier Mohammedan invaders of India, possibly because they were less firmly established in the country, permitted more of the features of Indian indigenous architecture than was usual, and Mr. Statham attributes this to the fact in the Jaina temples there was a form of plan similar to the normal mosque plan. At any rate there was for some time a mingling of Hindu elements with the features of the new architecture. The Jama Musjid at Ahmedabad is an example of a building of mixed Indian and Persian type. It was only when the Mogul Empire was established from, say, the time of Akbar that the Indo-Saracenic assumed a purer form. The great gate of Akbar's mosque of Futtehpur Sikri shows the development of Persian ideals with no trace of Hindu architecture, and in that category also are the Taj Mahal, the Pearl Mosque at Agra and the Tomb of Itimad-ud-Daula.

That was how the style grew, it grew not from the Arabs but from the art of more artistic peoples of the countries conquered by the Arabs and brought into the Islam fold; and it was only natural that such peoples, who possessed a living art when they were subdued, should have had an influence on the style as it progressed. They built to certain restrictions, but their genius was their own. As a converse case Mr. Statham mentions what happened in Sicily under Norman rule. The island had been Saracenic, but when the Normans were the masters they employed Saracenic artificers and the buildings erected, though not Saracenic architecture, showed details Saracenic in character. It was in that same way that the Moslem conquerors used the workmen in various countries and ultimately led to a definite Saracenic style. But the style, with all its beauty, is still an interlude like the religion of which it is the expression, owning no community outside its own limits, and having no bearing on the general march of architectural evolution.

Notes and Comments.

Jandola-Wana Road.—Reports from the Frontier indicate that progress with the construction of the road from Jandola to Wana has been satisfactory. The Mahsuds are evincing an enthusiasm in the making of the road and it is hoped that by Christmas the road will have been completed to Wana.

Herbert Morris, Ltd.—This well known firm of Loughborough, England, have sent us an illustrated booklet of their cranes, telphers, runways, pulley-blocks, boilers, conveyors, elevators, lifts and trucks, for which the firm are so famous. The publication throws an interesting light on the efforts being made by many British manufacturers to pay an economic wage without sacrificing profit. Valuable information is contributed by the letter-press.

New Railway Line.—Arrangements are being made for the construction of a new railway line from Champadanga to Tarakeswar, and a proposal has been put forward for the diversion of the Champadanga-Tarakeswar Road. The Hooghly District Board held a special meeting to consider the proposal and decided that it had no objection to the proposed diversion so far as it was necessary for the purpose of the proposed Champadanga-Tarakeswar Railway, provided the Railway authorities effected the diversion at their own cost.

Concrete Ousting Stone for House Construction.—An interesting example of the low relative cost of concrete as compared with stone comes from Chippenham where a tender has recently been accepted by the local council for thirty concrete houses which are to be built next door to a stone quarry. The tenders for concrete blocks showed a saving of 45 per cent. over those for stone blocks, despite the cartage entailed with the former. Aberdeen's granite tradition, too, is being assailed since concrete houses are springing up in various parts of the city.

The Shalimar Works, Ltd.—The Managing Agents for which are Messrs. Turner, Morrison and Co., Ltd., 6, Lyons Range, Calcutta, have taken over the work of pipe laying on a section of the 60-inch Pulta-Tallah main to finish it before the rains set in. As the Shalimar Works were laying a 60-inch pipe at Pulta under another contract they had sufficient pipes lying at Pulta and they were instructed to bring them to Paikpara Road and lay them there instead of at Pulta. The Shalimar Works have commenced the work on the gap of 800 feet in Paikpara Road.

Parry's Engineering Ltd.—Our thanks to this enterprising and go-ahead firm for a copy of their May-June 1928 catalogue, which is full of the most interesting information and which should be filed in every office for reference. The firm, which is growing strong, notifies a change of address, on and after 1st June 1928, from 11, Clive Street to 10, Clive Row. Telegraphic address and telephone numbers remain the same. The firm are well known throughout India as the manufacturers of structural work and light railway materials, and they are in addition sole agents for Orenstein and Koppel, A. G. Light Railway Specialists, and many other famous manufacturers. There is no engineering work that the firm cannot undertake, and thoroughly satisfy its customers.

Aero Club of India.—This club has received an offer from the De Havilland Aircraft Company which, if availed of, will mean a substantial saving in the originally estimated cost of equipment. The Government have provided a sum not exceeding Rs. 1,05,676 for the purchase of initial equipment for four subsidised aeroplane clubs. The proposal is to utilise the fund primarily for the purchase of eight of the latest type D. H. "Moth" aircraft fitted with 100 h.-p. D. H. engines and automatic slots, together with four spare engines of a similar type and such other initial equipment as may be necessary.

Acknowledgments.—We have received copies of the following excellent publications :—Burn's Engineering Magazine for March 1928; The Indian Concrete Journal for 15th May 1928, and The Brown Marine Magazine for May 1928, for which we thank the senders. They, one and all, convey information of great value and are a most welcome addition to our editorial table, for there are many callers who sit down to digest them. There are also many scientific and technical journals which fill a want for those interested in the subjects discussed, but which we are unable to notice in full.

Economy of Fuel on Indian Railways.—Mr. A. J. Chase, Director of Mechanical Engineering on the Railway Board, is presiding over a committee which is sitting in Simla to consider the question of effecting an economy on the consumption of fuel on the railways in India. The meetings are being attended by Mr. S. M. Avril, N. W. Railway, Mr. A. C. Robertson, E. I. Railway, Mr. W. E. Parish, E. B. Railway, Mr. S. Barber, G. I. P. Railway and Mr. P. C. Chopra, Statistical Officer, N. W. Railway. Mr. C. J. Chase, Offg. Director of Traffic, Railway Board, is Secretary of the Committee.

Bihar's Claim for Railway Advisory Committee.—The Bihar and Orissa Chamber of Commerce in a letter to the Railway Board strongly urges the formation of an Advisory Committee of the East Indian Railway for Bihar. The Chamber points out that there is an Advisory Committee in Calcutta, and another at Cawnpore, but Bihar is unrepresented. The interests of the provinces, it is added, are inadequately represented on the Calcutta Committee. The E. I. Railway has a mileage of about 1,053 miles in Bihar, and there does not appear any reason, therefore, why the province should not have an advisory body of its own to look after its requirements.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 9th May 1928 :—Messrs. Martin and Co., Calcutta—Spares, for Dragline Excavator, Rs. 1,910 c. i. f. Karachi; Messrs. Jessop and Co., Ltd., Calcutta—Spares, for electrically driven Feed-Pump, Rs. 1,380 free delivery at Peshawar by 15th August 1928; One Machine, diamond drilling, capable of 19/16 inch diameter, complete with fittings and spares, Rs. 6,435 f. o. r. Howrah by 11th June 1928; Messrs. The Lightfoot Refrigeration Co., Ltd., Calcutta—Spare parts, for plant welding and metal cutting, Rs. 1,524 c. i. f. Port Blair; Messrs. William Jacks and Co., Bombay—One Machine, Winget Concrete Block making, Rs. 2,550 free delivery at Kirkee.

Braithwaite and Co., Engineers, Ltd.—We are informed that the Railway Board have placed the order for the girders for the new Bally Bridge across the Hooghly with this firm. The contract is for Rs. 46,30,425. The girders will be fabricated at the firm's Clive Works at Kidderpore from steel rolled by the Tata Iron and Steel Co., Jamshedpur. The total weight of girders to be delivered is 17,266 tons. They are of 350 feet span and weigh 2,330 tons each. They are of the "through" type, the top tracing soaring 50 feet above the roadway. Between the main girders there is accommodation for two railways lines capable of carrying the most modern locomotives and heavy mineral trains. Outside the main girders there are two roadways, each 15 feet wide, and two footpaths, each 8 feet wide, carried on cantilever brackets over the road.

Karachi Port Trust.—This Trust have issued a statement showing the result of the financial working for the year ended 31st March 1928. The receipts (exclusive of Port Fund Account) were Rs. 65,65,965-6-6, while the expenditure (exclusive of Port Fund Account) amounted to Rs. 58,34,767-5-2, leaving a surplus of Rs. 7,31,198-1-4. The actual receipts of the year were less than the estimated receipts by Rs. 2,90,530-9-6. There was a saving of Rs. 10,12,109-10-10 between the estimated and the actual expenditure. The surplus of Rs. 7,31,198-4-4 is due chiefly to the sum of Rs. 6,56,125 which in the ordinary course should have been paid into the Sinking Fund, having been withheld as the amount in that Fund was found to be in excess of that required under the Karachi Port Trust Act. Had contributions been made to the Sinking Fund there would have been a surplus of Rs. 75,000 only.

E. I. R. Audit Office.—An important conference of heads of railway accounts departments of State Railways and the Director of the Railway Clearing House is sitting in Simla discussing the question of the transfer of the local audit establishment of the East Indian Railway from Calcutta to Delhi towards the end of the year. Messrs. Hayman and Hartley are representing the Railway Board. Those representing the various railways are Mr. Butterfield (E. B. Railway), Mr. Cameron-Kerr (E. I. Railway), Mr. O'Callaghan (N. W. Railway), Mr. Norbury (G. I. P. Railway), and Mr. Deane and Mr. Fakir Chand (Railway Clearing House). The main business before the conference is to take suitable steps to secure that the change from Calcutta to Delhi may be effected with the least possible hardship to the clerical establishment. The proposal it is understood involve the transfer of 500 posts.

Railway Standing Finance Committee.—An important agenda has been drawn up for the meeting of the Railway Standing Finance Committee in Bombay on 28th, 29th and 30th May when several new railway projects will be considered. The subjects to be discussed include the proposed constructions of the Chittagong-Nazirhat Railway, the Shaistaganj-Balia Railway, the Belapur-Shevgaon Railway and the Contai Road Railway. The other schemes to be considered are the constructions of the Amraoti-Narkhed Railway, the Nashrak-Thawe Railway, the Pollachi-Palghat Railway and the Sind left bank feeder railways. The revision of the superior cadre of the South Indian Railway, the creation of a post of statistical officer on the M. and S. M. Railway and a post of medical officer on the Eastern Bengal Railway will be the other subjects that will engage the attention of the Committee. A scheme for the recruitment and training of superior officers on the South Indian Railway will also be considered.

The New Nerbudda Bridge.—This bridge consists of six spans of 165 feet each and four spans of 40 feet, resting on lofty steel trestle piers over 100 feet high. The whole work was designed, made and erected in India, the Tata Iron and Steel Co. making all the steel required. The design of the steel works was made at Tatanagar in October 1926 and the steel sections were ordered at the end of that month. By the end of the year nearly 2,000 tons of steel had been delivered in Messrs. Braithwaite and Co.'s Malund works near Bombay. The foundations were extremely troublesome to make. On 7th May 1928 the last girder of the bridge was hoisted into its lofty position 114 feet above the river and on 1st June the E. I. R. Bombay Mail, the weekly Postal Express and the P. and O. Special will resume running on the direct route from which they were diverted when the old bridge was washed away in September 1926.

Punjab Irrigation.—The report of the Punjab canals for April 1928, shows an improved supply of canal water. The condition of the irrigated crops in the Northern Administration was generally good. Hail fell in certain areas irrigated by the Western Jumna and Sirhind Canals, and caused a slight damage in Karnal District. Owing to special works undertaken this year for constructing a groyne in the arm of the Chenab feeding the Wali Mohammad Canal, it was possible to open the canal in the first week of the month. In parts of the Phalia Division in the Southern Administration damage by hail had been quite heavy affecting an area of 5,000 acres. In Gujrat Division an area of 1,000 acres was damaged. A much improved supply was available in the Chenab and Indus as compared with last year. Serious damage was reported to wheat crops chiefly due to heat and dust storms in the Lower Chenab and Lower Jhelum circles. Burala Branch and other extension schemes on the Lower Chenab Canal are progressing satisfactorily.

Motor Transport in Africa.—The Cape to Cairo Railway was the dream of Cecil Rhodes, who lived long enough to see considerable progress made towards it from its south and north extremities. More recently a Trans-African highway has been advocated by Sir Abe Bailey. Yet it can truthfully be said that neither rails nor roads are necessary to-day for providing the transport services required for the commercial development of the Central African territories now that the rigid six-wheeled type of motor vehicle has given such abundant proofs of its capabilities for cross-country transport in districts where no roads exist. Both the Sudan Government in the north and the South African Railways in the south are operating very large fleets of Thornycroft six-wheelers, and some months ago Mr. Roger Thornycroft took one of these vehicles to Kenya and made the trip from Nairobi to Kampala in Uganda and back, demonstrating that the vehicle could operate over this difficult country with complete success. Shipments of these vehicles have since been made, and there

is little doubt that rigid six-wheelers will prove the key to the commercial development of Central Africa. In the words of no less a transport authority than Lord Montagu of Beaulieu, who took a Thornycroft six-wheeler through the desert country from Beirut to Baghdad, "easier, faster and cheaper lorry transport is needed in the undeveloped areas of the world, and the trip across the desert of this six-wheeler shows the direction in which the solution of the problem lies. I recommend all who doubt to try a six-wheeler of the Thornycroft type and they will agree with my conclusions."

Calcutta Filtered Water Supply.—We are informed that with the completion of the work of pipe laying on a section of the 60-inch Pulta-Tallah main in Raja Manindra Road, Paikpara, Calcutta will in about two months time have a much larger supply of filtered water than at present. This will be effected by extending the period of supply. If Calcutta could be supplied with filtered water continuously from 6 A. M. to 6 P. M., it would mean a greater pressure and a larger supply and the present acute distress of the rate-payers would be greatly relieved. The reservoirs in connection with the new water supply extension scheme for reception of filtered water from Tallah have already been completed. The Corporation is pushing on vigorously with the work of pipe laying on a section of the 60-inch Pulta-Tallah main. The department is making every effort to complete the work in as short a time as possible, but before any supply is sent to Calcutta for domestic consumption, it will be necessary to cleanse and flush the whole pipe system from Pulta to Tallah, which is expected to take some time. The waste of filtered water in Calcutta is enormous, but how to check this is a problem which has not been solved, there are many difficulties in the way.

Motoring Afloat.—From whatever view point, whether merely as a sport, a means of travel, or transport, the motor boat has increased in popularity in a most encouraging manner, both in England and Overseas. In England, the increase in road traffic, especially week ends and holiday times, has resulted in motoring becoming anything but a pleasure, and this road congestion, heavy taxation, and other restrictions are causing increasing numbers of motorists to seek an alternative and more pleasant form of travel. The motor boat, offering many attractions, is simple to handle, and demands no elaborate technical knowledge and makes possible, not only pleasurable day trips, but in the case of cabin craft, periods of cruising at a most reasonable cost. Motor boating has as one great advantage adaptability in the matter of cost, the range of prices at which complete craft may be obtained being almost as varied as the craft themselves, from the highly efficient yet moderately priced launch, to the sea-going cruiser of the last word in luxury. In the past, motor boating has suffered from lack of information, making an appeal to the new-comer, collaborated in a convenient form for easy reference. We were considerably interested to note, therefore, a valuable booklet, "Motoring Afloat," that has recently been published by the Marine Section of that important British body, the Society of Motor Manufacturers and Traders. Avoiding technicalities, it deals in a clear and concise manner with all phases of motoring afloat. Its facilities, upkeep, and insurance of craft, navigation directions, charts, the rules of the roads on river and at sea, with a special chapter on the Thames. These are but a few features of this compact and comprehensive book's information. "Motoring Afloat," which we note sells at *2s. 6d.*, a price which is moderate in comparison with technical literature of this description, is obtainable from the Marine Department of the Society of Motor Manufacturers and Traders, 83, Pall Mall, London, who are doing much to foster motor boating interests.

A Car for any Country.—As soon as the 14/45 h.-p. six-cylinder Talbot appeared it was welcomed as a fine example of British engineering skill which would go far towards suiting the requirements of motorists seeking a medium-priced "Six," a class becoming steadily more numerous and previously catered for chiefly by Transatlantic manufacturers. Since then more and more satisfied users, both at home and overseas, have testified to the excellent points of the car and their pleasure in owning and driving it. Mr. Massac Buist, for instance, lately become Editor of "The Autocar," and well known to overseas motorists by reason of his fluent pen, described himself as delighted with it; while other motor journalists who naturally try a large number of cars in the course of their work express enthusiasm over the riding comfort it affords. Overseas, "The Fourteen-Forty-five" has already made its mark. Last autumn a Melbourne owner competed in the 24-hour Reliability Trial there, travelling the full time and securing a gold medal for getting through without loss of points. This was very good, considering that the carburettor had the standard jets sent out by the manufacturers. In New Zealand, again, it has created great interest, as it is accepted as meeting the requirements of the Dominion and able to combat foreign competition successfully in the "small-six" class. A South African motorist purchased one of the cars during a visit to England and took it back to Cape Town with him. On arrival he proceeded to do a tour of 2,500 miles, much of which was over terrible roads. The Talbot, however, responded to all tests, and its steering won particular praise. The owner gives it as his considered opinion that in 26 years' motoring experience it is the least tiring car to drive. It certainly possesses a large number of features which appeal directly to the owner-driver. There is, for instance, exceptional cleanness of design throughout; there is a long handled plug for draining the oil sump, thus eliminating any necessity for undoing the usual type of screw plug, located right under the crank case. Similarly, oil filler and filter are readily accessible. Again, the means for adjusting the four-wheel brakes are simple. The tool box is incorporated in the dash, so that a complete set of tools is available for immediate use without disturbing other occupants of the car. Although the engine capacity is but 1,666 c.-c., it has remarkable powers of acceleration and gives a maximum speed of something like 60 m. p. h. Throughout its range, however, it is very smooth running. Altogether this latest product of a famous factory, which has a long list of successes to its credit, affords an added incentive to "Buy British," for it undoubtedly embodies very advanced features of design with simplicity of operation and upkeep at a very moderate price.

Current News.

MR. A. M. HAYMAN is on special duty in the Railway Board.

A COAL deposit has been discovered at Hwantzetung, Heiho, Manchuria.

MR. J. H. CHASE has been confirmed Chief Commercial Manager, North Western Railway.

MR. L. GREEN, Chief Engineer, East Indian Railway, has been permitted to retire from service.

MR. I. N. IYENGAR, Under-Secretary, P. W. I., is appointed to act as Deputy Chief Engineer, Reclamation Branch, Bombay.

MR. S. H. TAYLOR has been nominated a member of the Upper India Chamber of Commerce, *vice* Mr. A. N. Wilkinson, resigned.

IT is understood that the dispute over sharing the Cauvery waters between the Madras and Mysore Governments will be refered to arbitration.

THE unanimous report signed by the members of the Royal Commission on Agriculture at Mahableshwar in April will, it is understood, be published in the middle of June.

THE headquarters of the No. 1 Sanitary Provincial Division, Rawalpindi, now known as the Ambala Sanitary Provincial Division, have been transferred from Rawalpindi to Lahore.

THE temporary appointment of Deputy Secretary in the Bombay Development Department is extended up to 28th February 1929, and Mr. H. St. C. Smith is to continue to hold it.

THE services of Mr. B. H. Osmaston and Mr. E. Benoken, Deputy Conservators of Forests, United Provinces, have been placed at the disposal of the Government of India, Education Department.

THE headquarters of the Mailsi Provincial Division, Public Works Department, Punjab, are transferred from Lahore to Multan and the name of the Division altered to "No. II Multan Provincial Division."

MR. JAGANNATH SAKHARAM GURJAR, Farm Superintendent, Tharsa, Central Provinces, is appointed to officiate as Extra-Assistant Director of Agriculture, *vice* Rao Sahib G. K. Kelkar, Extra-Assistant Director of Agriculture, Nagpur, granted leave.

IN order to grant relief to the Cotton Mill Industry of Bombay, the committee of the Municipality have agreed to the Government proposal to reduce the town duty on the import of raw cotton consumed by the local mills from one rupee to eight annas per bale.

SEVENTY harbours have been constructed on the shores of the Great Lakes by the Canadian Government, exclusive of standing docks and jetties, upon the construction and maintenance of which the sum of 52,000,000 dollars has been expended since Confederation.

AT a meeting of the Commissioners of the Tittaghur Municipality, it was decided to aprove the scheme submitted by the Public Health Department, Engineering Branch, regarding the adoption of the "Simplex" System in the Tittaghur sewerage work at a cost of about Rs. 96,000.

THE air mail service inaugurated between incoming liners in the Gulf of St. Lawrence and Montreal last summer is to be extended to Toronto this summer. If this service proves satisfactory it is probable that in another year an extension of it as far west as Winnipeg will be attempted.

THE Assam-Bengal Railway Company have decided to replace the present signalling arrangements by modern equipments, with a view to deal with traffic more expeditiously. The Railway Board, it is understood, are in complete agreement with this proposal, and have sanctioned the appointment of a signal engineer.

THE London and North-Eastern Railway Company has placed an order with John Brown and Co., Ltd., Clydebank, for a twin-screw geared turbine passenger steamer of the shelter deck type for the service between Harwich and the Hook of Holland. The owners state that she will be the largest steamer on service on continental routes.

MR. A. P. MACDERMID, Superintendent, Works and Development and Acting Deputy Chief Engineer, B.-N. Railway, having proceeded on six months' combined leave, Mr. A. D. Carroll, Superintendent, Headquarters, is, subject to the Home Board's confirmation, appointed as Superintendent, Headquarters and Acting Deputy Chief Engineer.

THE Department of Construction of Kiangsu Province of China at the beginning of this year started to install long distance telephones in nine districts in Southern Kiangsu, namely, Nanking, Kintan, Küyung, Lishui, Liyang, Ihing, Changchow, Wusih, and Kiengyin. The Nanking-Lishui line is already complete and the other lines will be ready late in the spring.

Literary Notices.

The Design and Construction of Dams.—Including Masonry, Earth, Rock-Fill, Timber and Steel Structures, also the principal types of movable dams. By Edward Wegmann, C. E., M. Am. Soc. C. E., Consulting Engineer, New York, Author of "The Water Supply of New York, 1658-1805," "The Conveyance and Distribution of Water for Water Supply." With a mathematical discussion and descriptions of Multiple Arch Dams. By Fred. A. Noetzli, D. Sc., M. Am. Soc. C. E., Consulting Engineer, Los Angeles, California. Eighth Edition, Revised and Enlarged. Total issue, eight thousand. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Limited. 1927. Price, 87*s*. 6*d*. net.

This most sumptuous volume is one which no engineer engaged in the construction of dams can afford to overlook. It is a most informative volume and up-to-date. The author in his preface writes :—The First Edition of this book was published in 1888. It treated only of masonry dams, gave the theories upon which the design of such structures should be based, the methods of determining the profiles of masonry dams, proposed by different authorities, and the simple formulas, devised by the author for the proposed Quaker Bridge Dam, across the Croton River, which was to be more than 100 feet higher than any other existing masonry dam. This dam was never built, but the profile that had been designed for it was used for the New Croton Dam, 207 feet high, constructed in 1892-1907, about 1¼ miles up-stream from the old Quaker Bridge. According to information given the author by Consulting Engineer A. J. Wiley, of Boise, Idaho, the simple formulas given in this book have been used in recent years for designing the profiles of the Don Pedro and Exchequer dams, having maximum heights, respectively, of 285 and 333 feet...... In all editions descriptions of notable dams built in various parts of the world were given. The treatise seemed to have covered all kinds of dams. However, since 1908 a new type of masonry dams, known as multiple-arch dams, more economical in cost than any other type, has engaged the attention of engineers. A dam of this kind was built by a French engineer, in India, in 1802, and George L. Dilman pointed out in 1902 the advantages of this kind of construction, but it was not until 1908, when the late John S. Eastwood, a California Engineer, proved in competitive bids and by actual construction the economy of building multiple-arch dams, that a number of structures of this type, reaching in height upwards of 250 feet, have been built, both in this country and abroad. This treatise cannot, therefore, be considered complete, without including a discussion of multiple-arch dams. The author's friend, Fred. A. Noetzli, D. Sc., M. Am. Soc. C. E., of Los Angeles, Calif., has made a special study of this subject. He is, in the author's opinion, one of the best, if not, indeed, the best authority in America on multiple-arch dams. Mr. Noetzli has kindly offered to write for the author a mathematical discussion of multiple-arch dams and to describe such structures, built in this country and abroad, while the author brought the other parts of the book up-to-date ...... In the First Edition of this treatise, the author pointed out, for the first time, as far as he has been able to ascertain, that the most economical profile for a masonry dam, which has only to resist the hydrostatic pressure of water, is a right-angled triangle, having its vertical side up-stream. To resist the shocks of waves and floating bodies, this profile has to be reinforced near the top by an inverted triangle. Based upon these profiles, the author designed, what he called Practical Profile Type No. 1 and Practical Profile Type No. 2, which can be safely used for dams up to 200 feet in height. For greater heights the profile must be increased by the formulas given in this book, so as to keep the maximum pressures at the assumed safe limits. The Medina Dam, Texas, 164 feet high, was built according to the first of these practical profile types. The Don Pedro and Exchequer dams, mentioned above, approach closely to the second type. In 1924 the French Government sent a commission of engineers to America, to report on high masonry dams. This commission recommended in its report that such dams should be built with triangular profiles, a steep batter being adopted for the up-stream side and a flatter slope for the down-stream face, the two batters intersecting at the high water level. This book has grown in the present revision to 740 pages of text, 191 plates and 291 figures in the text. The pages measure 9 by 11½ inches. The volume is a very handsome one and does great credit to the publishers. The author is to be congratulated on the successful completion of his arduous task. His book is now a standard work on the subject of dams.

CORPORATION OF CALCUTTA.

Notice to Contractors.

TENDERS are invited in duplicate for the following and will be received by the **1st Deputy Executive Officer** on the date noted for each, up to 2 P. M. Each tender in duplicate must be enclosed in a sealed cover and superscribed—"**Tender for**..............." Specifications with tender forms in duplicate may be obtained during office hours from the **Central Record Office** on payment of Rs. 2 in each case. For further particulars apply at the Office of the Secretary. Tenderers must abide by the Corporation Rules in regard to tenders.

1. Supply and delivery of six-light Ukay copper street lanterns complete required for improvement of lighting in Upper Circular Road and Lower Circular Road.
2. Supply and delivery of six-light copper lanterns complete with super heaters required for improvement of lighting in Harrison Road.
3. Installation of electric lamps in some of the roads in Garden Reach.
4. Sinking 15 shallow tube wells in Garden Reach.
5. Supply and delivery of rubber valves at the Pumping Stations of the Corporation during the year 1928-29.

Tenders for 1 will be opened on 1st June 1928 (Friday), for 2 and 3 on 5th June 1928 (Tuesday), for 4 on 6th June 1928 (Wednesday), and for 5 on 18th June 1928 (Monday). The rates quoted in tenders for 1 and 2 are to hold good for three months and those quoted in tenders for 3, 4 and 5 for two months.

Central Municipal Office,
Dated CALCUTTA,
The *22nd May 1928.*

BHASKAR MUKERJI, B. A. (CANTAB.), B. SC. (CAL.),
Offg. Secretary to the Corporation.

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Foreign Notes.

Very-High-Pressure Steam Plant.—According to the "Electrical World," steam will be generated at 1,350 lb. per square inch in the new Deepwater (N. J.) station, which is jointly owned by the American Gas and Electric Company and the United Gas Improvement Company, and for which Messrs. Babcock and Wilcox, Ltd., have supplied four standard and two reheat boilers for operating at the above pressure. The standard boilers with a steaming economiser and air preheater will produce 331,000 lb. of steam per hour at 725 deg. F., and the reheat boilers will deliver 290,000 lb. of steam per hour and reheat 419,000 lb. of steam to 775 deg. F. The initial capacity of the generating plant of the station will be 118,500 kw., and the steam operating pressure for the turbines will be 1,200 lb.

Steel *versus* Reinforced Concrete for Bridges.—In a paper read at the recent Annual Convention of the American Institute of Steel Construction, Dr. Ralph Modjeski, the well-known consulting bridge engineer, thus sums up the advantages of steel for bridge construction as compared with reinforced concrete :—(1) Steel can be thoroughly tested before it goes into the structure. It can therefore be relied upon to carry the loads assigned to it better than reinforced concrete, which requires not only tests of cement and aggregates over long periods of time, but also a constant and strict supervision during construction. (2) The stresses in steel can be calculated with much more precision than in reinforced concrete. (3) The time required for steel construction is, in most cases, shorter than for concrete. (4) Steel construction may be carried on during freezing weather with perfect safety. (5) It is absolutely permanent when kept protected from moisture.

Copper Resistance Thermometer.—A copper resistance thermometer, designed as part of a new calorimeter for determining heats of formation of metal oxides and sulphides, has been constructed at the Pacific Experiments Station of the United States Bureau of Mines, Department of Commerce, at Berkeley. California. It had been planned to calibrate it at the melting point of ice, and at the transition temperature of sodium sulphate, 30 degrees higher. It has always been assumed that a linear relationship exists between the resistance of a copper wire and temperature in this short temperature interval. The sensitivity of the apparatus permits of division of 30 degrees into nearly 90,000 parts, and under these conditions it has been found that the resistance of copper departs considerably from the linear relationship. This means that the experimenters must establish several thermometric points intermediate between the other two ; but when this is done, the new calorimeter should be one of the most accurate and sensitive available.

Chilean Roads Construction Scheme.—The Chilean Legation in London has been advised by the respective Department of the Government that, in connection with the important project sanctioned recently for the construction of roads in various parts of the country, foreign contractors will be asked to tender for a considerable part of the work. The Government is at present preparing detailed plans, specifications, basis for tenders and all other particulars and information calculated to assist those interested in contracting for one or more of the sections for which tenders will be invited, and British firms interested should make early application for them to the Ministerio de Fomento, Santiago, Chile, through the Chilean Legation in London. The scheme provides for the construction of new roads and the improvement of existing ones in several parts of the country, some of the most important being :—(*a*) Province of Aconcagua, five roads comprising a total distance of 218 kiloms. ; (*b*) Province of Santiago, seven roads comprising a total distance of 316 kiloms. ; (*c*) Province of Colchagua, one road of 55 kiloms. ; and (*d*) Province of Concepcion and Nuble, one road of 80 kiloms.

Extra-heavy Rail Sections.—Heavier steel rails are coming more and more into use in the United States to meet conditions imposed by heavier and denser traffic. Rails of 100-lb. section and over, rolled in 1927, were more than two-thirds (68·84 per cent.) of the year's production of all rails. Only three times previously had the ratio passed one-half. In 1926 it was 61·12 per cent.; in 1925, 58·76 per cent.; in 1923, 50·47 per cent. In keeping with this rapidly growing proportion of the heavier sections, the decline of 12·78 per cent. in total rail production last year was confined almost wholly to rails of under 100 lb. to the yard. The drop in the heavier sections was only 1·66 per cent. Recognising the growing importance of the extra-heavy rail sections, the American Iron and Steel Institute has now made a separate grouping of those rails weighing 120 lb. or over. The total for 1927 is given as 617,524 tons, or 22·01 per cent. of all the rails produced last year. This action recalls that of thirteen years ago, when for the first time the 100-lb rails were segregated from the 85-lb. and over classification, previously the heaviest reported. At the time this new group constituted 27·18 per cent. of the year's tonnage.

Flotation Tests on High-Silica Bauxites.—Laboratory flotation tests on high-silica bauxites made by the United States Bureau of Mines, Department of Commerce, at its Southern Experiment Station, Tuscaloosa, Alabama, have given results which compare favourably with results of earlier fractionations made by means of heavy solutions. Indications are that the laboratory flotation machine can be depended on to give a good separation between the clay and the bauxite, provided that these two constituents have been sufficiently liberated from each other by crushing, and provided that the crushing has not produced an excessive amount of slimes. The principal reagents used consist of sodium sulphide and oleic acid. Recent tests indicate that only a comparatively small amount of these reagents is required for the flotation of the hydrous aluminium oxide minerals. One sample of bauxite recently experimented with showed that an amount of sodium sulphide equivalent to 5 lb. per ton of ore was sufficient to give a well-sulphidised pulp. Flotation tests of high-silica bauxite are now being made in 500-gramme machines, and it is hoped that it will be possible to duplicate the results that have already been obtained with a 50-gramme machine.

Driverless Motor Car.—A message from Berlin states that on 12th April trials were carried out at Ruessellsheim on the Main, with a driverless motor car propelled on the Rocket system, and a speed of 430 miles per hour was attained for a few seconds. Herr Opel claims that there is practically no limit to the speed that could be reached by the new machine, which has the appearance of the ordinary racing car, except that the back part consists of a steel chamber with twelve round openings, out of which penetrate the steel pipes from which the rockets are discharged. Fuses are connected with the pipes and are linked up on an automatic switchboard, and are controlled by the driver's seat. The rockets are discharged by means of an electric spark and a sheet of flame bursts out from behind the car, which is said to shoot off at a terrific speed enveloped in a cloud of smoke. A drawback to the invention is that the rockets are very expensive. The machine is to be taken to Berlin this month for trial purposes, and the attempt will be made to beat the British world's speed record with a car that will run on rails, for which purpose the German railways are placing a suitable stretch of railway line at the disposal of the Opel Company.

Electricity in Canada.—The Canadian Dominion Bureau of Statistics has just issued its preliminary report on the Central Electric Station Industry in Canada, giving figures for the calendar year 1926. Electrical energy supplied in Canada is almost wholly based on water power, the output of hydro-electric stations during 1926 having been almost 99 per cent. of the total of all generating stations and their dynamo capacity—dynamos driven by water wheels—was over 95 per cent. of the total. Nevertheless, the number of fuel power plants was considerable, aggregating 301. Only fifteen of the fuel stations had capacities above 1,000 kva., but they produced over 80 per cent. of the output of all fuel plants. Of the output of 11,911,039,000 kilowatt-hours generated in 1926 by hydro-electric stations, fourteen plants with capacities of 50,000 kva. and upwards generated over 70 per cent. The ratio of their output to their maximum capacity was 51·4 per cent., which was considerably higher than for the majority of the stations. Production of electrical energy increased during the year by nearly 2,000 million kilowatt-hours, owing mainly to the rapid increase in the pulp and paper and mining industries. The pulp and paper industry in Canada uses enormous quantities of power, much of which is produced by the mills themselves, but large blocks are purchased from central electric stations. The total capital investment in the industry increased during the year from 726,721,087 dollars to 756,220,066 dollars.

Railway Improvements in France.—In their annual reports the French railway companies give a full account of the works they have carried out during the past year, and the Orleans Company refers more particularly to the reconstruction of the permanent way with heavier ballast, new rails and manganese steel points. The number of sleepers is being increased from 21 to 27 per length of 16·5 m. of rail. It is noted that, on the electrified lines, the total consumption of energy during the year was 109 million kilowatt-hours, 70 per cent. of which was supplied by the Eguzon hydro-electric power plant. In the coming autumn the Coindre Power Station will be supplying additional energy for the railway. The coefficient of working costs was reduced, and the financial situation of the electrified lines appears to be improving. Another interesting feature of the report is the reference to the part which the railway companies are taking in developing road transport services, particularly in districts where the traffic is too light to allow of local lines being worked at a profit. All the railway companies are preparing programmes for combined rail and road motor vehicle services, and as attempts to resuscitate moribund local lines with the aid of rail motors have not been uniformly successful, it is probable that such lines will, in time, be abandoned altogether in favour of road vehicles run by the railway companies. They seem to be in a fair way to obtain a monopoly of road transport within the territories covered by their system. The report of the Orleans Company states that this combination of rail and road transport is the "Working formula of the future."

Water for Port Elizabeth.—Owing to the prolonged drought the position at Port Elizabeth with regard to water supply recently became somewhat serious, though rain subsequently fell and relieved the situation. In order to try and avoid a repetition of the shortage, the City Council has accepted the report and recommendations submitted by Messrs. R. W. Newman, M. Inst. C. E., and D. P. Howells, M. Inst. C. E., regarding augmenting the City's water storage. At present there are three reservoirs with capacities of 29, 124 and 184 million gallons. The present capacity of the pipe lines is 2½ million gallons per day, but a new line from Bulk River to the Linton service reservoir is now approaching completion, and has a capacity of 2 million gallons. The report recommends work at all three storage sites. At Van Staadens an entirely new dam, with a 60 feet wall, 375 feet long at the crest, is proposed, below the old dam. New filters of the pressure type will be required. This section is estimated to cost £30,000, and will give an additional 70 million gallons of storage capacity. At Bulk River it is proposed to raise the existing wall 10 feet, carrying the new work up from the foundation level on the downstream side of the wall and thoroughly sealing the foundations by cementation. The cost is given as £35,000, and this work will provide an extra 200 million gallons capacity. At Sand River another 200 million gallons of water storage will be secured by raising the wall an extra 15 feet, at a cost of £36,000. It is estimated that the work at each site will occupy about eighteen months. In the meantime temporary measures are suggested for the raising of the top water levels at Van Staadens and Sand River reservoirs by about 2 feet in each case. In addition to adopting these schemes, immediate steps are to be taken to investigate new sources of supply. The total storage capacity on completion of the works decided upon will be 716 million gallons.

General Articles.

THE ROCK-HEWN CAVES OF ELEPHANTA.

HOW ANCIENT INDIAN ENGINEERS CARVED TEMPLES OUT OF ROCKS.

It is impossible to withhold admiration for the marvellous way in which, two thousand years ago, Indian engineers, with very limited equipment, carved out wonderful temples in the solid rocks. Most of these belong to the Buddhist period, but other faiths also adopted this method. It is well worth while for engineers to visit these caves, for they certainly give an impression of very high skill and enterprise on the part of the architects and engineers. Many are still in a good state of preservation, as, naturally, they have not been subjected to the effects of the climate. The caves of Elephanta are on an island six miles from Bombay, which derives its name from a large mass, like an elephant, cut out there. After the head fell off, the body was placed in Bombay. In the main temple the pillars are massive, and arranged in lines parallel to one another. The length from the entrance is 130 feet, and the breadth from east to west 130 feet, so that the temple is almost square. The plan is regular with seven pillars and a pilaster in each from before backwards. In this chief temple, to the right on entering, is an enclosed space with four doors facing north, south, east and west, the Lingam shrine, there are doorkeepers who are represented leaning on demon dwarfs. The Lingam, the emblem of Siva, is a cylindrical stone about two feet in diameter which is worshipped on great occasions by devotees who come in great crowds. This is therefore called a Siva Lingam Temple, a class of sacred building very common in India. The most striking thing in this temple is the sculptured mural bust which faces the chief entrance and can be dimly seen from it (from) in the recesses of the cave. It is three-faced and is therefore known as the Trimurti. This is a representation of Siva in various forms; the front has Brahma, the creator; that on the left is Rudra, the destroyer; while that on the right has Vishnu, the preserver, holding a lotus flower in his hand. This is a very fine piece of work and is in an excellent state of preservation. Another striking sculpture is in his character of Ardhanariswar or half male and half female deity, uniting both sexes in one person. The same tradition is represented in a carving at Badami. The bull accompanying is called Nandi, and is a constant attendant on Siva. To the right of this figure is Brahma on his lotus throne, supported by five swans, and with his four faces, a portion of each of which is visible. To the left is Vishnu riding on a headless Garuda, a fabulous creature, half man and half eagle. Above and in the background are numerous inferior gods, and Indra, the lord of the firmament depicted on an elephant. In the compartment on the other side of Trimurti are gigantic figures of Siva and Parvati 16 and 12 feet high. They are surrounded by attendants and by symbols of all sorts. Siva has four arms, one is resting on a dwarf who seems to bend beneath the weight. The marriage scene is represented also, as is seen by the fact that Parvati stands at the right hand of Siva, where the Hindu wife stands only on her wedding day. Brahma with his four faces stands by as priest of the gods reading the marriage service. Behind the bride stands a male figure pushing her forward. This is probably her father, Himalaya. Siva and Parvati figure again in another group, representing Skandra, the war god, who figures so prominently in Kalidasa's fine poem, the Kumara Sambhava; in yet one more compartment is the image of Ravana, the demon king of Ceylon, attempting to remove Kailas, the heavenly hill of Siva, to his own kingdom in order to have his deity with him, for Ravana was ever the worshipper of Siva. Ravana has ten heads and twenty arms. Siva is on Kailas with Parvati on his right and the rishis in the background. The legend runs that Ravana shook Kailas so much that Parvati was alarmed, whereupon Siva pressed down the hill on the head of Ravana who remained immovable for ten thousand years. Crossing over to the corresponding compartment on the other side is seen the representation of the sacrifice of Daksha. He was the son of Brahma. Walking through the caves one sees a large number of these massive figures all of which show how skilled were the old sculptors who followed their fathers in applying the rules long accepted for this kind of work. The fine Trimurti and the two gigantic figures of Siva and Parvati perhaps give the best idea of the large scale on which this work was done. The figure of Siva is 16 feet high, while that of Parvati is 12 feet 4 inches. Behind the main hall on the east side we find a very fine open court which is 55 feet wide, in the centre of which is a platform on which, doubtless, at one time, an image of Nandi was placed. There is a flight of steps leading up to one temple, and the lions on these are fine examples of Indian art. The shrine of the temple itself measures 14 feet by 16 feet. It is interesting to visit the west wing of the caves where there is a large open cistern, a feature not often seen in these rock caves. While the modern engineer may not be interested in the carvings of the many gods, he cannot but be impressed by the way in which this detailed work has been carried out. He will also be struck by the exact way in which the many pillars have been carved, first from the solid rock, and then covered with elaborate carving. The Elephanta Caves were cut out later than most of the others, those at Ajanta, Karla, and Ellora, the date usually given being between the ninth and eleventh centuries.

THE KENNEDY V_o FORMULA.

II.

In continuation of the previous article under the same heading, the writer feels called upon to explain how Kennedy's V_o Formula is affected thereby.

There is first the question of the observed v. If these are irremediably in error, there is nothing to go upon; and further and more accurate observations must be made.

If Kennedy's bed-widths (denoted by B to avoid confusion) are each $= b + t$, then the required m_p of the proposed P. K. Formula are obtained from b and d, and not from B and d (see the results for C_o obtained from Kennedy's data, and published elsewhere in Indian Engineering).

$$B = b + \frac{35d^2}{9(b + 4d)}$$

Approximately :—

$$B = \frac{(b + 2d)^2}{(b + 4d)}$$

Whence :

$$b = \sqrt{\left\{\frac{B(8d + B)}{4}\right\}} + \frac{B - 4d}{2}$$

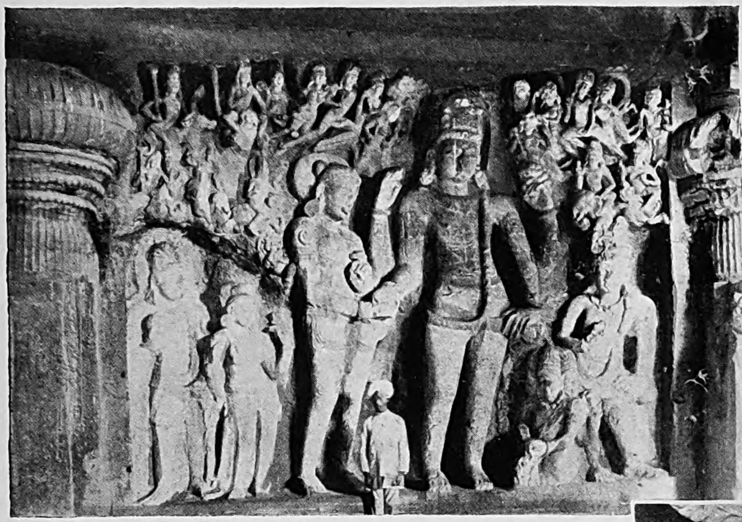
and the approximate result must be adjusted with t by trial and error, because :—

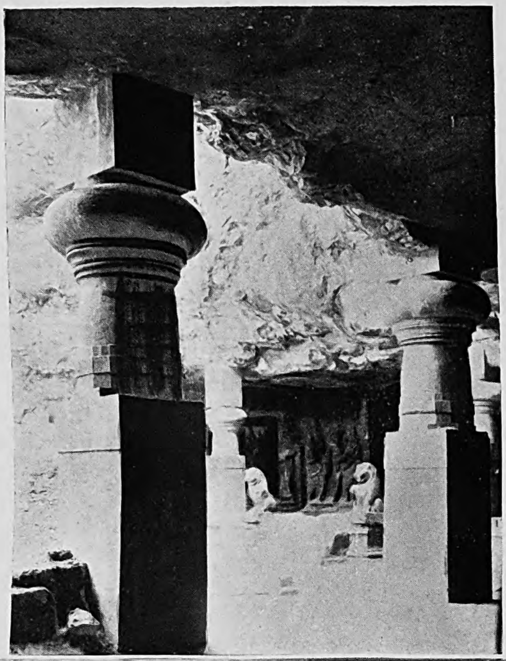
$$t = \frac{35d^2}{9(b + 4d)}, \text{ exactly.}$$

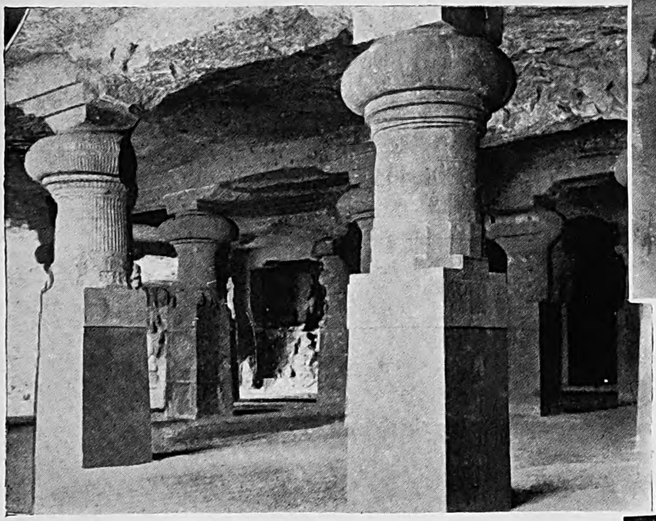
$$B = b + t, \text{ exactly.}$$

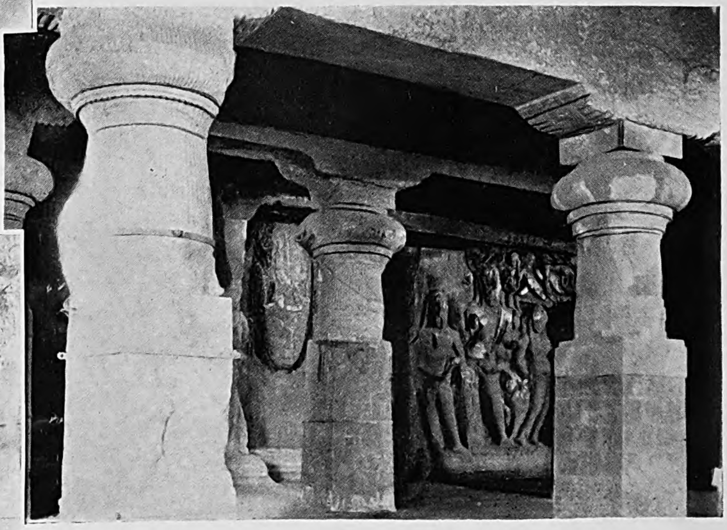
If now, we take Kennedy's observed v, and find C for each, with the corrected m_p, so that :

$$\text{Obs. } v = C\sqrt{m_p}$$









1.—Marriage of Siva and Parvati. The man below serves to give an idea of the height of the figures.
2.—Entrance to Temple.
3.—The pillars in the Main Hall.
4.—An Interior view of Ellora Caves.
5.—A Damaged Sculpture.
6.—Showing part of the fine Trimurti.

THE ROCK-HEWN CAVES OF ELEPHANTA.

we shall have a wide range of values for C, from which a great deal of information can be extracted. These C appear to vary, so far as the writer has calculated them, between 1·028 and 1·261; and the writer ventures to assert that, if the observed v were correct, where C exceeded *about* 1·201, the section had scoured larger than denoted by the calculated m_p, and where C fell below *about* 1·201, the section had silted unduly.

The theory amounts to this:—

A. In a newly dug channel with a bed-width of construction b, the required m_p can be calculated by the equation,

$$m_p = \frac{3b + 5d}{3b + 12d} \times d$$

and with a suitable value of C such that $V_o = C_o \sqrt{m_p}$ always, there will be neither scour nor deposit, once the channel has acquired the water-worn Pyramid Section GHC, see the figure in the previous article.

B. With an ancient channel, the matter must be dealt with as stated at the commencement of this article, B and d carefully determined and b calculated. The procedure thereafter is the same as in A above.

It has not been thought worth while to prepare the following table with excessive accuracy, because Kennedy registers B to the nearest foot, and d to the tenth part of a foot, only. [The correct procedure is to prepare a table of b-values, connected with B, by means of the factorized units x, y, etc., the result being very compact and labour-saving, especially if logs as well as quantities are entered.]

The table shows the sensitiveness of C as a measure. It shows also the cross-rigidity of Kennedy's V_o, see Nos. 18, 19, and 20, for example, as compared with the cross-flexibility of the P. K. V_o, which adjusts itself to any b and d in combination. The results for the larger channels show up well; for the smaller channels the P. K. V_o would appear to be the safe ***maximum*** velocity, and Kennedy's V_o might be the ***minimum*** when irrigation outlets are discharging, and the flow is, as a consequence, irregular. It is for the Canal Engineers to decide.

The writer suggests, from the common experience of all Public Works Engineers, that Kennedy undertook the work only in such leisure as his duties afforded; and the extent of that leisure can be gauged by any hard-working officer. No doubt, Kennedy had to rely upon a good deal of information from others, as hard-worked as himself, perhaps not quite so enthusiastic, nor such good observers. It is very probable, besides, that he was able to devote more personal time to the main canal sections than to the branches. The difficulties of observation in a running canal, with its momentarily varying losses and discharges, should also be remembered. And the discharge of a huge canal is not so easily or accurately measurable as that of a water-supply main. That sections Nos. 15, 17 and 20, were abnormally scoured, and sections Nos. 21 and 24, unduly silted, seems likely; unless some better explanation can be adduced.

Ref. No.	B	d	t	b	m_p	Obs. v	C	Ken. V_o	C_k	Pyr. V_o	C_o
1	85	7·0	1·7	83·3	5·973	2·86	1·170	2·92	1·195	2·934	A constant value = 1·201; log. ·079358
2	84	6·9	1·7	82·3	5·889	2·91	1·199	2·89	1·191	2·913	
3	86	6·8	1·6	84·4	5·833	2·90	1·201	2·87	1·188	2·900	
4	68	6·7	1·9	66·1	5·573	2·75	1·165	2·84	1·203	2·834	
5	80	6·6	1·7	78·3	5·629	2·83	1·193	2·81	1·184	2·848	
6	70	6·5	1·7	68·3	5·455	2·81	1·203	2·79	1·195	2·804	
7	55	6·5	2·6	52·4	5·243	2·59	1·131	2·79	1·219	2·749	
8	66	5·7	1·4	64·6	4·833	2·55	1·160	2·56	1·165	2·639	
9	66	5·5	1·4	64·6	4·685	2·55	1·178	2·50	1·155	2·598	
10	48	5·5	1·7	46·3	4·467	2·40	1·136	2·50	1·183	2·537	
11	50	5·2	1·5	48·5	4·290	2·52	1·217	2·41	1·164	2·486	
12	61	5·0	1·2	59·8	4·269	2·33	1·128	2·35	1·137	2·480	
13	36	4·8	1·5	34·5	3·799	2·25	1·154	2·29	1·175	2·340	
14	22	4·5	2·1	19·9	3·253	2·15	1·192	2·20	1·240	2·165	
15	14	4·0	2·2	11·8	2·657	2·00	1·227	2·04	1·252	1·957	
16	18	3·9	1·9	16·1	2·781	1·90	1·139	2·01	1·205	2·002	
17	18	3·6	1·6	16·4	2·618	2·04	1·261	1·91	1·180	1·943	
18	16	3·0	1·3	14·7	2·213	1·70	1·143	1·70	1·143	1·786	
19	14	3·0	1·4	12·6	2·146	1·70	1·160	1·70	1·160	1·759	
20	12	3·0	1·6	10·4	2·063	1·80	1·253	1·70	1·184	1·724	
21	14	2·8	1·3	12·7	2·035	1·60	1·122	1·62	1·136	1·712	
22	15	2·6	1·1	13·9	1·951	1·60	1·146	1·55	1·110	1·677	
23	8	2·3	1·3	6·7	1·524	1·40	1·134	1·43	1·158	1·482	
24	11	2·2	1·0	10·0	1·599	1·30	1·028	1·39	1·099	1·518	

The writer has now completed his own work on the hydraulic flow, and will write no more thereon, except to reply to criticisms. He has found it a fearful strain; and could only have carried it out in retirement. He had hoped to develop in like manner a factorized-conic Pyramid theory on Catchment Areas, but he views the appalling investigations and calculations he must make with despair. For the present, at least, he must rest upon his oars, having rowed himself out to pass this winning-post, with what success it is for others to say.

St. George's Day, 1928. Σ. Φ.

NOTE.—The decimals to three places in the table were taken out by inspection from the logarithm book, and involved no additional labour. The Catchment Area theory is partially stated already in INDIAN ENGINEERING, and with the hydraulic theory as guide, should not be too difficult in re-discovery.

Σ. Φ.

THE WATERWAY OF BRIDGES AND CRAIG'S FORMULA.

THE article with this heading which appeared in the issue of 19th November 1927, has evoked comments from "A Correspondent" and from Mr. Lillie (G. E. L.). The criticism of the former is contained in two articles (issues of 28th January and 11th February) while Mr. Lillie's article is in the issue of 18th February 1928.

"A Correspondent" notes the omission of the coefficient C—"the important flood moderator" as he styles it,—from the article of 19th November. It is true that C was introduced by Craig in the beginning of his investigation, but no values were assigned to it and it was eliminated before the final formula was determined, and in these circumstances its inclusion was considered to be unnecessary. With reference to another remark by "A Correspondent" it is only necessary to say that the area of cross section of a channel (whether of a canal or natural stream or closed pipe) multiplied into the mean velocity through the section must give the rate of discharge through that section.

The next objection is that B is *twice* Craig's B; but with B equal to half the base of the isosceles triangle the numerical factor would be 880 instead of 440; and "A Correspondent" will see this worked out in INDIAN ENGINEERING of 21st April 1923 (to which he himself gives a reference in his first article) or in Vol. ccxvii. of Procs. Inst. C. E. (correspondence p. 378). Craig undoubtedly took B to represent the extreme width to begin with, although in the final formula it is stated to be the *mean* width and is *included* in the summation. This is only one of the inconsistencies of the formula.

In assuming that his element of area was covered with water to a depth of i inches and that this was flowing down the catchment with the uniform velocity v feet per second Craig assumed in effect that the contribution to the peak discharge was 440 vi cusecs *per mile of width*,—$5280 \times \frac{i}{12} \times v$. As i and v are constants Craig assumed that the contribution of an element of area was proportional to its width b, the contribution to the peak rate of discharge being proportional to the greatest width B. Further (and Craig apparently had an eye all the time on the flood *area*) as v must be the velocity *through the outfall*, the contribution to the flood area $\left(\frac{D}{v}\right)$ is B i mile-inches or 440 B i square feet. This is the essential principle of Craig's formula but he approaches the solution in a roundabout way. He gets the rate of discharge from the whole triangular area as $440\, v\, i \int \frac{b\,dl}{l}$; and as $\frac{b}{l} \times dl = \frac{B}{L} \times dl = db$, the rate of discharge can be expressed as equal to $440\, v\, i \int db$. Summation of course gives the maximum contribution to be 440 B v i as obtained more directly above!

From another point of view. In the time t taken by the element to reach the outfall the volume discharged is the volume contained on the triangle of length l and base width b, *viz.* $\frac{1}{2} \times 5280^2 \times \frac{i}{12} \times bl$ cubic feet, and as $t = \frac{5280l}{v}$ the *average* rate of discharge is $\frac{1}{2} \times 440$ b v i. The *maximum* rate of discharge is *twice* this when the element of volume passes through the outfall in the element of time $dt = \frac{5280\ dl}{v}$, *i. e.*, 440 b v i as already shown. This explanation is tedious but it is necessary in order to expose the confusion of thought,—and in view of the remarks by "A Correspondent" at the beginning of his second article. Cubic feet divided by seconds will certainly give *a* rate in cusecs, but for *the* rate there must be some relation connecting the volume discharged and the time in which it is discharged.

The remarks above answer some of Mr. Lillie's comments as they show that Craig's original assumption—when the errors in his method of development are corrected—was that the flood area of waterway is proportional to B. The quantity i (inches) was of course a difficulty but this is not overcome by Mr. Lillie's suggestion to change it from a length to a rate (inches per hour). He reasons that then $i \times d\,w$ is the rate (square mile inches per hour) at which rain is discharged on to an element of area; and as the contribution to the discharge at the outfall cannot ordinarily be at this rate owing to the distance of the element; the contribution of this and similar elements will vary inversely as their distance (y) from the outfall. Hence the contribution of an element will be $i\,d\,w \times \frac{K}{y}$. Now it will be seen that this is *not* a discharge rate (square mile inches per hour) but a rate of mile-inches per hour, or *an area per hour.* The reducing factor should be a ratio of y to L (or some function of that ratio) if the discharge rate in square mile inches per hour is to be maintained. It appears to the writer that attempts to arrive at the flood section $\left(\frac{D}{V}\right)$ through the flood discharge rate must fail owing to the large range of V, and the difficulty of finding *both* D and V. By assuming (as Craig did unknowingly) that the flood section varies as B,—to which assumption known cases lend some support,—the difficulties connected with D and V are circumvented.

To revert to Mr. Lillie's expression $i\,d\,w \times \frac{K}{y}$ for the contribution of an element of area and examine the conditions from another view-point. Instead of dw take an area m_5, a portion of a catchment that will drain off at the outfall in the 5th hour from the beginning of the rainstorm; and suppose that i inches fall on this area in the first hour. Absorption reduces the depth to $C \times i$ say so that the *volume* available to flow at the end of the first hour is $C\,i\,m_5$ (square mile inches) and this will be the contribution of m_5 in the 5th hour, supplementing volumes from the intermediate areas m_1, m_2, m_3 and m_4. The interval of time being one hour the discharge rate will also be $C\,i\,m_5$ (square mile inches per hour), —$u_1\,m_5$ of the articles on "Rainfall and Run-Off." The rainfall is supposed to be continuous for the five hours and the reducing factor C depends upon the rate of absorption in the first hour, and is *quite independent of the mean distance* y *of the area* m_5 *from the outfall.* The distance y is a measure or index of the time that must elapse before the area m_5 *feeds in* at the outfall and its quota depends on the duration and intensity of the rainstorm and the condition of the soil with respect to absorption.

There are grounds for assuming that the flood section varies somehow with B, and in framing the formula $S = 1320\ M^{\cdot 48}$ the writer took a catchment of average length $(L = 2\sqrt{M})$ as being sufficiently approximate in ordinary cases. As mentioned in the article of 19th November, this formula gives areas that are too great for small catchments (under 100 square miles) and for some exceptional cases such as the lower reaches of the Punjab rivers and the Kali Nadi which is a "plains" catchment. On the other hand Mr. Lillie contends that a formula giving S as a function M_a alone cannot even remotely approach reliability.

Mr. Lillie's remarks regarding the writer's comparison of the waterways at Adamwahan and at the Gunjal viaduct on the G. I. P. Railway are, it is freely admitted, to the point, and it is only necessary to say that the idea underlying the comparison was—how would it answer to substitute the 8 spans of 73 feet for 16 spans of 250 feet at Adamwahan? The writer has since seen Mr. Howden's paper and noted the great flood depths; and Mr. Granville has given extracts from the paper in INDIAN ENGINEERING of 24th December. From the cross section it appears that for a flood of 25 feet depth (84 above datum) 2½ spans on left and about one on right are quite ineffective. What the conditions were on 22nd July 1864 when the record flood (104 above datum) occurred it is difficult to gather from the narrative—"Work was begun in 1862 and girders fixed by commencement of monsoon of 1866 and the whole completed for inspection early in 1867." The embankment may or may not have affected the flood level, and the feature in this case is the comparatively great flood depths, due presumably to the rocky nature of the soil.

J. F.

THE REVOLUTION IN PHYSICS.*

BY SIR OLIVER LODGE.

(Concluded from page 280.)

PARENTHETICALLY, I call attention to the sentence in this paragraph: "Lorentz's ether was, in fact, merely space endowed with certain properties." That also I take to be the view of Einstein, and I find no fault with it. The ether is synonymous with what we call empty space, except that it is by no means empty; it is only empty of matter. It is space with physical properties, it is space become substantial; it is no longer merely geometrical space. It is a plenum able to be treated physically, and no longer a mere subordinate interval furnishing room to move about in. It is able to do things, to transmit vibrations, to be the seat of electric and magnetic and gravitational fields; it is amenable to law and order, and is able to satisfy certain equations. It has constants that can be determined; and when we have more knowledge I believe that it will be amenable, not only to calculation, but to experiment too. At present it is elusive, and some therefore think it illusory. But although we have no means of getting at it in any satisfactory manner at present, it would be a mistake to try to shut the door to further inquiry, and to deny its existence, merely because we do not see how to explain its properties. If we like to call it "space" instead of "ether" there is no objection; but remember that it is space with physical properties, and all physical properties are legitimate subjects for physical inquiry.

To return from this digression. Then came the remarkable experiments of C. T. R. Wilson, whereby in a sense he may be said to have rendered both atoms and electrons visible, at least when flying at high speed, by the streak of condensed vapour which congealed round the path of the travelling charge. True, the particles themselves are not visible, but their residual effects are; that is, the residual effect of each single particle. Under these circumstances, it is almost a matter of words whether we say we can "see" the particles or not when we look at their individual streaks. For what does it mean when we say we "see" an object? All that we get from it is certain ripples in the ether, which enter our eye. From that, by long practice, we infer the object. Looking at waving branches, we infer a wind. Looking at a moving needle, we infer a current. Looking at a mist, we infer the globules of which it is composed, or even the nuclei round which those globules are condensed. Looking at the movements of a column of mercury, we infer a rising or a falling temperature or even a coming storm. Innumerable things in physics are not given us by direct observation, but by indirect inference.

So it is with electrons and atoms. So it is also, I venture to say, with the ether. Professor Eddington had an ingenious illustration of this use of language when we say that we "see" something. He pressed his thumb on a photographic plate and developed the impression. Anyone shown that plate would probably say, not that it was a smudge, but that it was a human thumb; and a finger-print expert might be able to say after examination that it was Professor Eddington's thumb. In that same sense when we "see" C. T. R. Wilson's streaks of condensed vapour we can say that we see the track of an electron or an atom or an ion. We can see their track, or at least minute drops congealed along that track, but we are far from seeing or knowing the shape and structure of the things that produce the congelation. Is there any way of learning anything about them?

The arrangements of atoms in a molecule, which at one time could only be determined by the remarkable instinct of chemists, is now being made almost visible by aid of X-rays and the patterns which they produce after passing through or among such molecules, thereby supplementing and often confirming the previous blindfold, though brilliant, anticipations of chemists. Long immersion in phenomena develops a wonderful insight. Going on still further, the arrangements of electrons in an atom have now been almost rendered visible to the mind's eye by the genius of Bohr and his co-workers, with detailed additions due to Sommerfeld and others.

Is there any way of arriving at the shape and transformations of an electron? I suppose not yet. But still I have thought in that direction, and have been impressed with the work of Poincaré and Langevin; and though I fully expect to be told that I am somewhat out of date, and though it may be a mistake to hark back to what I wrote some years ago, especially in these days when progress is so rapid, though perhaps not so secure, that anything a year old is sure to be superseded, I will venture in this Kelvin Lecture to call attention to these comparatively antiquated ideas, in the belief that even what has been discarded may contain some features which are instructive, and even possibly a few features which are true.

Let me hark back therefore to the only quasi-dynamical theory of the ether which seems likely in any degree to survive, or perhaps to be revived only by posterity, namely, the hydro-dynamical ether or perfect incompressible fluid in vortex motion—the fine-grained rotational structure or vortex sponge, which was worked at both by Kelvin and G. F. FitzGerald. I may in a note or appendix give a kind of summary of the lines of this mathematical investigation, which confessedly is not entirely satisfactory, but which, nevertheless, is very suggestive as far as it goes. I can here only summarise its main outcome.

The problem was, and always has been, how a substance which filled all space, without the least obstruction or resistance to the passage of matter through it—that is, which did not in the least interfere with the motions of the earth or any other heavenly body, and which therefore seemed to have the properties of a perfect non-viscous incompressible fluid or liquid—how such a liquid could, nevertheless, transmit transverse vibrations, such as can only be transmitted in the case of ordinary matter by solids with a certain amount of elastic rigidity; that is to say, by materials capable of elastic deformation and recovery. It was always known that no ordinary fluid could do this, it could only transmit vibrations at all if it were compressible; and the waves transmitted must be longitudinal waves, like those of sound. Newton it was who first investigated the transmission of sound, and showed that the speed was the square root of the ratio of pressure to density. That is all ancient history.

* Abstract of Kelvin Lecture delivered before the Institution of Electrical Engineers, from "The Engineer," 20th April 1928.

But now arose the question whether a fluid in vortex motion could transmit transverse waves. For vortices have many of the properties of a gyrostat; that is to say, properties naturally conferred upon them by rotation. And a gyrostat has a peculiar reaction to force, tending to move in a direction at right angles to the force, so that any impulse or disturbance might be expected to be transmitted in an unusual way. The result was to show that, given a medium full of minute vortices, circulating with a certain speed c, transverse waves akin to those of light, and therefore capable of polarisation, could be transmitted, and that they would travel, according to Lord Kelvin's calculation, with a speed $\frac{\sqrt{2}}{3}c$; that is, with about half the speed of circulation. FitzGerald's inquiry made the wave speed more nearly equal to c, but anyhow they were of the same order of magnitude.

Well, that possibility has not been followed up, nor that structure in the ether developed, because of many difficulties about stability and the like. Nowadays, however, a doubt about stability is not fatal, since something unexpected, like the quantum, may always come in to stabilise things. Bohr's orbits were not stable till the quantum arrived; and even now no one can fully explain the quantum, though, once admitted, it is perceived to have stabilising qualities, since it emphasises whole units, and declines to admit fractions; in other words, it rejects continuous changes and insists on discontinuity; jumps rather than slides, staircases rather than slopes.

But a more deep-rooted objection to any even quasi-dynamical theory is that all such attempts seemed superseded and rendered unnecessary by Clerk Maxwell, who showed finally and completely that the lateral or transverse disturbances associated with the propagation of light were electric in one direction, magnetic in the other, and not mechanical at all. Yes, that is undoubtedly true; but that is not the final word, it does not end the discussion. For what is an electric displacement in the ether, and what is a magnetic field? There always seemed something rotatory about magetism, and, if so, there must be something which rotates. Electrification and magnetisation themselves want explaining; they are not functions of matter, they must be explained in terms of an etheric medium; and a gyrostatic or rotational medium is just what is wanted. According to Larmor's theory, a magnetic field is itself a kind of vortex, a bundle of filaments, with a flow along the lines of force, a flow which presumably constitutes the energy of the field.

If there is such a flow it must be excessively slow, for it has never been observed. I have specially looked for it.* But it is far too small. I have not given up all hope of observing it; but I have reason to think that an enormously strong field will be necessary before any trace of etheric motion becomes perceptible. If I were younger, I should like to press Dr. Kapitza into the service, and utilise his very striking methods of producing enormous currents and correspondingly strong magnetic fields, so that his coils have to be strengthened lest they fly asunder or explode under the magnetic stress. But although Dr. Kapitza can produce small local fields of enormous strength, even he cannot yet extend them over the length required to give a chance of detecting, by means of a beam of light, what I estimate to be a leisurely etheric crawl along the lines of magnetic force.

But why should it be so small? The answer is, Because the ether is a substance of tremendous density, utterly different from such estimates of density as were made by Lord Kelvin in the nineteenth century. For my estimate of ether density and its reasons reference can be made to the *Phil. Mag.* for April, 1907, page 488. Various modes of getting at it are therein indicated, and they, too, all lead to a result of the same order of magnitude, namely, about 10^{12} in c.g.s. units assuming such units at least analogically applicable.

It may be asked, What does the density of ether mean? To that I can only reply—as usual—inertia per unit volume. And as to what "inertia" means, I can only say, Something very fundamental, perhaps the most fundamental thing in the physical universe, incapable of reduction to anything simpler. We know that the inertia of an electron is explicable in a fashion, in terms of its electrostatic field, which exists in the ether all round it. It seems to carry some ether with it when it moves, and its inertia is due to that, or rather to the magnetic field which is generated by the motion. This it is which causes its motion to persist, and which reacts against acceleration of any kind. But that is not a fundamental explanation of inertia. It only throws the mass of a moving speck upon the surrounding medium. The same must be said even if the electron is reduced to waves, and the momentum of waves is appealed to. Waves would not have any momentum unless the substance carrying them had inertia. I expect that it will be found that all inertia exists in the ether fundamentally. And if so, whether the estimate of 10^{12} is right or not, many physicists, including the high authority of J. J. Thomson, admit that etheric density must be incomparably greater than any known form of matter, even such exceptional matter as exists in the few known stars like the Companion of Sirius. For, after all, "matter" inevitably is a collection of discrete particles with interspaces between them, and, in itself, has no more substance than a thin cloud of dust or mist; it is like some granules of dirt distributed through an ocean of clear water.

If, for the sake of argument, you will grant me the high density of the continuous medium in which the particles of matter exist, and of which they are presumably composed, let us go back to the vortex structure of this ether, and the rate at which it transmits waves. Whatever we are ignorant about concerning the ether, we know this one thing definitely and accurately—the speed of radiation. It is a great speed, 3×10^{10}. Nothing in matter can approach it. It is only rendered possible by the extraordinary properties of the ether; but there is nothing haphazard about it or accidental, as would be the case with projectiles shot off. It is the speed, and the only speed, with which anything whatever is transmitted by the ether as soon as it gets free from contamination with matter. It is a definite and universal constant in really free space, and applies to every wave, however long and however short. And if that is not true, the error—at present quite unlikely and unsuspected by anybody—must be left to far-distant posterity to detect and substantiate.

* See *Phil. Mag.* for April, 1907, pp. 495 to end; also Preston's "Light," p. 316, for part of the apparatus.

The Gazettes.

Bihar and Orissa, May 16, 1928.

Irrigation Department.

Mr. Balmukund, Executive Engineer, is, on return from leave, reposted to the charge of the Champaran Division.

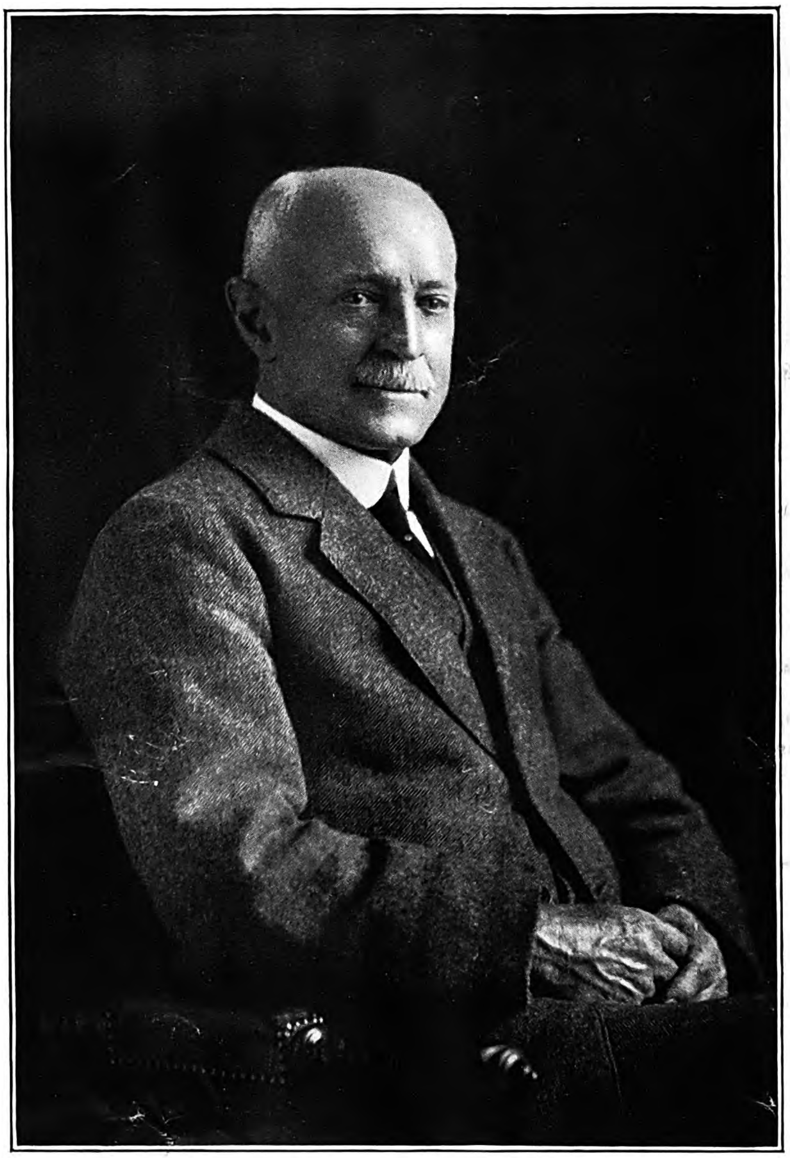
Punjab, May 18, 1928.

Buildings and Roads Branch.

On transfer from the Sialkot Sanitary Subdivision of the Lahore Provincial Division, which he left on 14th April 1928, Mr. D. N. Gautum, Temporary Engineer, took over charge of the Multan Sanitary Provincial Division, on 16th April 1928, from Mr. D. A. Howell, Executive Sanitary Engineer.

Mr. J. A. R. Bromage, Executive Sanitary Engineer, took over charge of the Lahore Sanitary Provincial Division, in addition to his own duties, on 16th April 1928, from Mr D. A. Howell.

On transfer from the Sanitary Circle, which he left on 17th April 1928, Mr. J. S. Sethi, Personal Assistant to the Sanitary Engineer to Government, Punjab, took over charge of the Lahore Subdivision of the Lahore Sanitary Provincial Division, on 18th April 1928, relieving Mr. T. B. Madnani of the additional charge.



SIR FREDERICK SPROTT.

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INDIAN ENGINEERING.

SATURDAY, JUNE 2, 1928.

SIR FREDERICK SPROTT.

AMONG the earlier Coopers Hill engineers there were quite a number of men of a certain type, men who with excellent all-round abilities combined prowess in games and pleasant personalities, and who with these assets gave a very good account of themselves in their professional careers. Frederick Lawrence Sprott may be said to have been fairly typical of that group. A son of Mr. James Sprott of Shrewsbury, he was born in 1863, and educated at Shrewsbury School in the years 1877—81, prior to his technical training at the Royal Indian Engineering College from 1881 to 1884. Academically, he passed out last of those who were sufficiently high on the list for appointments to the Public Works Department of India, bracketed equal with Mr. G. C. Stawell, who subsequently served with some distinction in Bengal and Burma, and retired as Chief Engineer and Joint-Secretary to the Burma Government. They both wanted Bombay and tossed for the choice. Mr. Sprott won the toss and was posted to the Bombay Presidency in 1884, Mr. Stawell going to Bengal. In all games Mr. Sprott was exceptionally proficient, he played full back in the Rugger Fifteen, also for a time for Surrey, and he was in the Eleven and in the Tennis team throughout his College days. Cricket appears, however, to have been his special game, he played for the Bombay Presidency from the time when matches were first started in 1891 almost to the end of his service in India, and captained the Eleven for a good many years. One of his most successful efforts was in the match, Bombay *versus* Madras Presidency, at Ootacamund in 1893, when he made 91 runs, not out, and caught or stumped eight men in the two innings of Madras. He still plays cricket in Derbyshire, and only last year, playing for Derbyshire Friars against Leicestershire Gentlemen, he went in first with Mr. H. R. N. Ellison (now Revd.), well known at one time as a cricketer in India, and the two, their united ages being 123, knocked up a big score.

On arrival in India, Mr. Sprott was first sent to Belgaum, and thence for the charge of the Yellapur Subdivision of North Canara. In that sportsman's paradise he was initiated to big-game shooting under the guidance of a great shikari, Colonel Peyton of the Forest Service. Colonel Peyton was so fine a shot that the confidence of his men in him was unbounded. Mr. Sprott used to relate the story of the occasion when he was following up a wounded tiger in company with the Colonel, who was at that time recovering from a bad accident, caused by a fall from his shikar ladder, in which, among other injuries, he had broken a wrist and a leg, and could only walk supported by a stick in one hand and the other arm round a man's neck. Yet it was impossible to keep the men, clearing a way through the dense jungle, back from danger. They said: "The Colonel

Sahib has shot at the tiger, therefore it must be dead," and sure enough they came upon it dead as mutton. That, however, by the way. In the Deccan, Mr. Sprott was employed on the ordinary duties of an Assistant and Executive Engineer, he was on the completion of the Lake Whiting dam and the erection of Reinolds' automatic gates on waste weirs, and for the rest his work was mainly that of maintenance of canals, roads, buildings and water-supply works. But from the advancement he subsequently received to posts lying outside the usual departmental duties, he was doubtless recognised as being a good man. He was Principal and Professor of Civil Engineering, College of Science, Poona, from 1889 to 1903; on the Indus River Commission, with the rank of Superintending Engineer, from 1904 to 1908; Sanitary Engineer to the Government of Bombay from 1908 to 1909; and in 1909 he was seconded for service with the Bombay Port Trust as Deputy Chairman. Sir Walter Hughes was then proceeding on leave, and Mr. Sprott acted as Chairman in his absence; and when Sir Walter retired in 1910 he was appointed permanently as Chairman, and continued to hold that post until he himself took leave preparatory to retirement at the close of 1917.

The Chairmanship of the Bombay Port Trust may be said to have been the most conspicuous feature of Mr. Sprott's career. It was a post of great responsibility, during the war there were doubtless many special difficulties, and in taking over from Sir Walter Hughes, Mr. Sprott had no very easy man to succeed. Sir Walter had an intimate knowledge of Bombay, he had been Secretary to Lord Reay and Lord Harris, and in 1892 was appointed Chairman of the Trustees of the Port. Into the duties of this office, he threw himself very whole-heartedly, and was engaged in many improvements when the visitation of bubonic plague in Bombay led to the creation of an Improvement Trust. Sir Walter Hughes was the first Chairman of this Trust, and after a period of anxious work on it he rejoined the Port Trust in 1900. The resumption of his former post was the beginning of a time of very exceptional activities. Sir Walter was fortunate in possessing the confidence and support of the Chamber of Commerce and the mercantile community, and with their co-operation he set himself to improve trade facilities in many important ways. There was much heavy work in progress when Mr. Sprott succeeded him in 1910, and his successor had not the advantage he possessed of familiarity with every detail of it. The great Alexandra wet dock, with a water area of 50 acres and 16,035 lineal feet of quays, was under construction; and there was the Hughes' dry dock, 1,000 feet in length with 100 feet entrance, at the time the biggest dry dock in the world; and in addition the designs for the warehouses, railway sidings and other subsidiary works had to be settled. The progress, however, continued to be so good that the two immense docks were sufficiently advanced to be opened by the Viceroy, Lord Hardinge, in March 1914, and in June of that year Mr. Sprott received the honour of knighthood, a distinction he had well deserved.

In addition to the docks, the schemes in contemplation included the removal of the Cotton Green from Bombay to Sewri, the construction of a large grain, coal and ore depôt, together with the Port Trust Railway and the necessary receiving yards from the G. I. P. and B. B. and C. I. Railways and the complicated siding arrangements. Though the length of the Port Trust Railway was only 3½ miles or thereabouts, the sidings outside the docks extended to over a hundred miles before Sir Frederick Sprott left India. The work, moreover, involved the reclamation of an area of about 600 acres, for which two large suction dredgers were obtained. The subsequent covering of this reclaimed area necessitated the construction of a railway to carry muram and hard soil from the Island of Trombay. The railway also brought the earth required for the raising of the large area of low-lying rice lands at Wadala for the reception and sorting yards, and for the sorting yards there had to be gravity sidings. Special measures were necessary to carry the railway across the soft mud which had been pumped by the dredgers. Altogether, the work was not of a simple and straightforward kind, and it was much hampered by the war and by the fact that a large part of the newly reclaimed areas had to be set apart for the use of military operations. Special arrangements had also to be made on the outbreak of the war for laying sidings for the despatch of troops, sidings which continued to be used throughout the war; and an important change in the working of the Port made at that time was the inauguration of a Department to supply all the dock labour which had previously been supplied by contractors. This Department was very highly tested during the war and acquitted itself well. Sir Frederick's energies and business abilities were therefore very fully employed during his period of service in Bombay, especially as he was also a member of the Bombay Legislative Council, and Chairman of the Victoria Jubilee Technical Institute at a time when a change was made in connexion with the control of technical education, in accordance with which the Victoria Jubilee Technical Institute became the Central Institute for Technical Education in the Presidency and a new building had to be erected for it at Matunga.

On leaving India early in 1918, Sir Frederick was asked by the Government of Egypt to break his journey at Port Said and advise on certain matters connected with port and harbour work at Port Said, Suez and Alexandria. This work he undertook, and afterwards had some exciting and not too pleasant experiences as the convoy, of which his ship was one, was twice attacked by hostile submarines and narrowly escaped disaster. On arrival in England he was appointed a Director on the London Board of the G. I. P. Railway, a post he held for two years, until he decided to go to Kenya and interest himself in coffee growing. At Kenya he was appointed the unofficial representative of the Railway Council and

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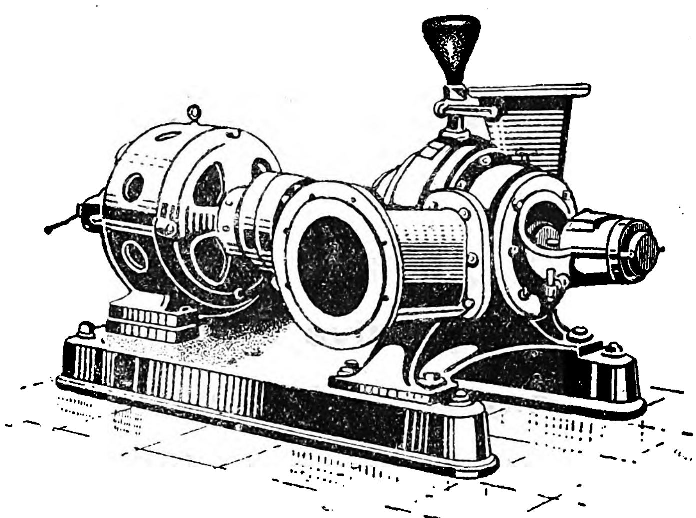

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was elected a member of the Legislative Council. He remained in the Colony for about four years, when, though he was inclined to make his home there, he found it necessary to return to England for family reasons. By that time he was sixty-one years of age, and no doubt felt that he had earned a rest, he had done meritorious work in India in several important posts, more particularly as Chairman of the Bombay Port Trust, and he has every claim to be considered one of the best men that the Royal Indian Engineering College has produced. In offering him our congratulations on his career, it is pleasant to think that his constitution is so little impaired after his labours that in his sixty-fifth year he is still an ardent and successful cricketer.

CANAL AND CIVIL PATWARIS.

When it was decided to transfer canal revenue management from the Canal to the Civil Department as an experiment in the Western Jumna Canal Circle of the Panjab, any sensible person would have known that the experiment was foredoomed to failure. At any rate it did fail, the agriculturists clamoured against the innovation, in fact no one seemed to be in favour of the Civil Department's management of canal affairs, and after careful consideration the Government decided to restore the former system. But that only makes it the more curious that, when the deputy-collector and zillahdar establishments were transferred back to the Canal Department, the combined canal and civil patwari should have been retained. The arrangement, by which the "amalgamated" patwari draws his pay from the Civil Department and his bonus from the Canal Department and is expected to serve two masters, is a thoroughly unsatisfactory one, and the authorities would be well advised not to permit it to continue. It can only be assumed that the two sets of officials having been given the same title, that of patwari, it was supposed that their duties overlapped and that economy would result from the amalgamation. For if the Canal Department had at the outset called the canal patwari, *abpashinavis* or *abnavis* or *pashinavis*, or some such different name, it would have been generally accepted that the two classes of men were employed in different ways, and then any idea of amalgamation would have led to a close and detailed examination of the nature of the work done at the very foundations of two separate systems before any change was made.

The civil patwari, to mention a few of his duties, has to record the constantly occurring mutations in order that the record of rights may be kept up to date; he has frequently to attend the law courts in civil suits affecting the land; and when settlement operations begin he is placed under the orders of the settlement officer (not under two masters) to form the nucleus, the backbone or—as it were—the steel frame around which a temporary, and very considerable, expansion of staff takes place. The canal patwari is not concerned with any of these matters. He is daily going his rounds, writing up his irrigation register as irrigation of the fields proceeds; he examines and reports on all cases, as they occur, of waste of water, unauthorised irrigation or dubious use of water; he has to attend his superior officers when they periodically check his irrigation register and field measurements, and make local enquiries into his own reports and into the objections and claims made by the cultivators; and, lastly, when the crops are ripening, he has to write up the final measurements, going over the entire ground in accordance with a fixed programme of operations, and then to prepare the demand statements and to distribute to each cultivator the *parchis* or demand slips. This last duty is very important, and it has to be carried out expeditiously without fail in order that cultivators who desire to lodge objections to the demands may do so before crops are cut and removed and all proof obliterated. There are times, long periods, at least twice a year, during which the canal patwari should be every day and all day occupied with his canal work undisturbed. He cannot at such times attend at law courts, or pay his respects to the Tahsildar, or carry out any Civil Department duty. In these circumstances, the dovetailing of the work of the two Departments, so that one man can do, and do efficiently, what two men did before, would seem to be practically impossible.

To regard the question in yet another light. In a non-canal-irrigated area, the field of operation of a civil patwari depends on such conditions as density of population, size of holdings, nature and extent of cultivation, extent of agricultural or industrial occupation, and the general prosperity of the people. The introduction of canal irrigation causes a change, and the growth of population, wealth and activities in all directions renders the size of the patwari's circle unmanageable. A readjustment becomes necessary, the circles have to be smaller and the number of the patwaris greater; but, properly arranged, the patwari should still be too busy to have any spare time for another man's job. On the other hand the canal patwari's zone of work is regulated by the area irrigated and the intensity of the irrigation, as indicating the amount of work involved. The size of the canal patwari's circle is calculated to keep the patwari in charge of it working at high pressure at least during the biennial periods of final measurements and demand statements preparation. During the rest of the year the work may not be so strenuous, but no man can work at high pressure all the year round and the patwari will have little or no spare time for additional duties. If in the irrigated areas the civil patwari were dispensed with, the size of the canal patwari's charge would have to be reduced, or there would be a risk of inefficiency, and the increase in the number of canal patwaris, as against the reduction of civil patwaris, would not necessarily make for economy. There would be no reduction of civil patwaris in the unirrigated tracts of a civil district, and there would thus be in the one district two kinds of patwaris, some under one master and the others under two, and for

administrative purposes these patwaris would not be interchangeable.

If amalgamation work in any irrigated district under a single patwari were feasible, it might reasonably be inferred that one, or other, or both lots of patwaris were being underworked, in which case the proper remedy would be a reduction of staff and an increase in size of circle. But there would seem to be little reason for the adoption of a thorny system, the economy of which would be very doubtful, while the loss of efficiency would be certain. Amalgamation can only lead to disappointment, trouble, confusion, and friction all the way down from the deputy commissioner to the patwari and the canal executive engineer to the same patwari, owing to the dual form of control. The old system in the Panjab, by which the complete responsibility for the management of irrigation works in their engineering and revenue aspects was imposed on the engineers whose sole business it was to devote their whole time to acquiring knowledge of the art of irrigation, is incontestably the right system and the only system which will enable the country to obtain the full advantage of works which have cost immense sums of money. In the chain of that system of canal administration the patwaris are essential links, and they should be wholly under the orders of the canal officers, undistracted by civil duties foreign to the interests of canal work. It is a common-place truth that no man can serve satisfactorily two masters; and if the name is an obstacle there is no difficulty in giving the canal patwari a designation, such as *abpashinavis*, which would be appropriate and would by the appellation show that the duties were separate and distinct from those of the patwari of the Civil Department. Taking into consideration the conditions of work as above stated, the strongest advocates for amalgamation might well hesitate to press for a system which strikes at the very root of sound administration.

VIZAGAPATAM HARBOUR.

THE "Indian State Railways Magazine" of March last contains a capital article by Colonel Cartwright Reid, C. B., on the Vizagapatam Harbour, a work which has been in contemplation for many years. India, as a late President of the Institution of Civil Engineers said, has, considering the great length of coast line, few ports for the accommodation of vessels alongside quays. The physical configuration of the county accounts for this. On the west coast, for nearly a thousand miles, a little distance from the seaboard, there is a range of hills, with summits over 3,000 feet in height, which makes access to the sea difficult. These hills, known as the Ghats, composed of volcanic rock, are very precipitous, and south of Bombay some few hundreds of miles of coast are cut off from railways, and between Bombay and Marmagoa there are only three roadways from the highlands to the low country. On the west coast of Burma, there is similarly a 500 miles length separated from the hinterland by the hills. The ports of India are therefore not numerous, and beginning from the northern end of the Arabian Sea there are Karachi, Bombay and Marmagoa, the last with a small trade mainly in manganese ore. At the extreme south of India, between India and Ceylon, there is a ferry service, and in the north, on the east coast, there are the ports of Madras and Calcutta. The head of the Bay of Bengal has Chittagong, and Burma has Rangoon and the lesser ports of Moulmein and Bassein. But between Madras and Calcutta, on the east coast, there is a tract with a coast base about 600 miles in length, which was so sparsely populated that a port seemed little needed, and on that coast lies Vizagapatam. A sea-port, as Colonel Cartwright Reid says in his article, has been described as one foot in the sea and one on land, and is the point of exchange between land and sea transport. But it was only when the Bengal-Nagpur Railway provided land transport in that particular locality that a harbour as an outlet for it began to attract attention. Once there was the railway, a port for it held out the prospects of the development of an entirely new trade route between the Central Provinces and the sea, and the final outcome was the Vizagapatam scheme, the execution of which, after protracted negotiations, was undertaken by the Railway Board through the Administration of the Bengal-Nagpur Railway.

Colonel Cartwright Reid was appointed Engineer-in-Chief of the work in 1921, he had previously much experience in harbour works in Canada, Malta, Scotland, Belgium and elsewhere, and he has done admirable work at Vizagapatam. Vizagapatam was chosen as a sea connexion as it was geographically a convenient position and its physical features were suitable for the construction of a port. The estimate for the first section of the harbour amounted to Rs. 2½ crores, and the main items of the scheme were the dredging of the basin to a depth of 30 feet at low water to give ample depth for large ships, and to afford accommodation for seven vessels as a beginning, a provision which can be added to when justified by increase of trade. The area of land acquired is over ten square miles, and therefore gives space for future additions. Of the seven berths for ships, three will be alongside a quay wall, 1,500 feet long, built with a granite face, and equipped with eleven electric cranes to run along the whole length of the wall. A special berth is being provided for the export of manganese ore, and a dry dock is being built, principally to take the dredgers and other harbour vessels, but which will also accommodate steamers engaged in the coasting trade. The Director of Town Planning, Madras, has prepared a scheme for the town planning of the swamp area, lying between the harbour works and the town; and in addition to the railway connexion between the Central Provinces and the harbour, the Bengal-Nagpur Railway authorities are providing special facilities for the harbour traffic. Vizagapatam is likely to be an important sea-port town in time.

Notes and Comments.

William Asquith (1920) Ltd.—This firm, who are the world's largest and leading drilling specialists and whose works are situated at High Road Well, Halifax, England, has sent us two beautifully illustrated catalogues of their portable universal radial drilling machines and high speed drilling machines. Both are real works of art and furnish full particulars regarding the respective machines. They should find a place in every workshop of note.

Vickers Ltd.—Messrs. Vickers Limited announce that the following gentlemen have been appointed Directors of the Metropolitan Carriage, Wagon and Finance Co., Ltd.:—Mr. J. P. Crouch, Mr. R. C. Irwin, Mr. G. G. Sim, Mr. Howard Williams, and that Mr. T. L. Taylor (Chairman and Managing Director of Taylor Bros and Co., Ltd.) and Mr. Alexander Spencer (Chairman of Spencer Moulton and Co.) have been appointed Chairman and Vice-Chairman, respectively.

Aerial Survey in Bihar.—The possibility of employing aeroplanes for cadastral survey operations in Bihar and Orissa has been investigated during the past year. One of the advantages of aerial survey is that it obviates the necessity of dragging chains through standing crops. It is, however, more expensive than the ordinary methods of survey, and the Government have decided to await the results of aerial surveys that are being carried out in Bengal before experimenting in this province.

T. U. C. Delegation Report.—A black picture of labour conditions in India is painted by two members of the home Trade Union Congress who recently returned to England after a tour in India. The report describes the workers as "half starved, badly clothed and horribly housed," and an attack is made on the authorities regarding "overcrowding and insanitary conditions." The British labour movement is asked to take the step of linking up the two labour movements with the object of "lifting the Indian workers from the morass of filthy and ghastly conditions, social, moral and physical."

Erosion of River Jumna.—Dealing with the erosion of the River Jumna at Serajganj, the Chief Engineer, Irrigation Department, Government of Bengal, states that nothing can be done at a reasonable expense to prevent this encroachment of the river. The cost of protection is, he adds, likely to exceed the value of the property protected. The Government are under no obligation to protect private property, neither has it the funds to do so. Moreover, the Government have to be careful not to create awkward precedents. If they succeeded in diverting the river from one point, they may be let in for damages due to erosion at another.

Fruit Cultivation in Mysore.—The Government of Mysore have now accepted the recommendations of the local Board of Agriculture in regard to the question of loans for fruit cultivation in the State, and have passed orders to the effect that no interest be charged for the first three years on any loan granted for fruit culture up to 30th June 1930, that the time fixed for commencing repayment of such loans be fixed at from three to five years according to the circumstances of each case, and that a sum of Rs. 10,000 be provided each year for the grant of loans for fruit cultivation. Loans not exceeding Rs. 3,000 in any single case will also be granted for the purpose of organizing nurseries of fruit trees, for planting or improving fruit gardens of more than one acre in extent in the State.

New Zealand Afforestation.—An interesting insight into afforestation is being provided by a cinema picture entitled "Forest Wealth" now being shown in the Punjab. The picture summarises the work being undertaken by the Perpetual Forests Company, Limited, in New Zealand, to replant the denuded forest areas of the country, and brings out every detail of the project, showing the care bestowed on the young trees to bring them to the stage at which they are sufficiently strong to be planted in their final positions, the rate of growth with proper management, etc. It is interesting to note that India has subscribed considerably to the funds of the project.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 16th May 1928:—Messrs. Martin and Co., Calcutta—2 Excavators, dragline, "Ruston," 135 and one No. 75, steam driven, on caterpillars, 100 feet boom, 3 cubic yard bucket, complete with spares, Rs. 3,83,880 free delivery erected at Damodar Canal Headworks; Messrs. Jessop and Co., Ltd., Calcutta—340 cwts. Rounds, M. S., ½ inch, Tata, Rs. 3,878 free delivery Dera Nawab; 100 cwts. Rounds, M. S., ½ inch, Tata, Rs. 1,140 free delivery Dera Nawab; 145 cwts. Pig Lead (Burma, refined), Rs. 3,002 free delivery Simla.

Glenfield and Kennedy, Ltd.—We have received from this well known firm of Hydraulic Engineers (Incorporated in Scotland) a copy of their recently published Stock Price List of Valves, Hydrants, Meters and other Water Supply Fittings. It is well illustrated, which is a great help to purchasers. The firm are manufacturers of sluice valves, hydrants and all classes of water and sewerage works fittings, hydraulic machinery, pumping machinery, irrigation sluices, Kennedy's patent water meters, etc. The firm are contractors to the Admiralty, India Office, War Office, Crown Agents for the Colonies, etc., etc. The Calcutta Office is in Fairlie House, Fairlie Place, P. O. Box No. 2115, Calcutta.

Locomotives for India.—In the House of Commons on the 24th May last, replying to Mr. Kirkwood, who declared that the contract for 48 main line locomotives for the Indian State Railways had been placed with Continental firms, and asked whether any fair wage conditions clause had been imposed upon Continental manufacturers, Earl Winterton said that no such contract had recently been placed by the High Commissioner for India. Tenders had been called for a large number of locomotives and boilers, and at present they were being considered by the High Commissioner, but no orders had hitherto been placed. The form of contract used by the High Commissioner always contained a fair wage clause.

War Memorial in Turin.—Turin will shortly possess the biggest bronze monument in the world, for Senator Agnelli, chairman of the Fiat Automobile Company of that city, has just offered, as a memorial to soldiers who fell in the war, a statue surmounted by a searchlight, having a total height of 87 feet. The monument, which represents a female figure holding a light, is more than 60 feet high and called for the use of 25 tons of bronze. It is mounted on a

base of nearly 400 cubic feet of granite. The monument will be placed on the summit of one of the highest hills surrounding the city of Turin. It is claimed that this Italian monument is the biggest bronze casting in the world, for while the Liberty monument in New York harbour has a greater height, a large part of it is in welded sheet steel.

Hans Renold, Limited.—This English firm of Burnage Works, Didsbury, Manchester, have mailed us a copy of their most recent publication on "Renold" Chains for conveying and elevating and their accessories. In a letter they write that it is impracticable to even outline the special advantages which these chains have to offer over the hitherto inadequate and unadaptable chains used for this purpose. Suffice it to say that they are a series of high grade steel precision chains, which are the result of considerable experience and investigations into the requirements of the market for the mechanical handling of goods. Available in a large range of strengths and a variety of pitches, they are designed to give universality, with higher speeds, smoother running and less expenditure of power. The publication is fully illustrated.

Allegations Against Officer.—A contractor named Gokul Singh has addressed a petition to the Agent of Burma Railways alleging that Mr. J. H. Rickie, in collusion with contractors, has obtained a sum of Rs. 56 lakhs from the Railway over and above the contractors' reasonable profits. Mr. Rickie has brought a case against Gokul Singh for defamation. Interesting developments are expected to take place in the inquiry. In such cases the fullest publicity is called for, such as was accorded to the details of the Harvey-Nariman case, in the interests of both parties and of the Government department concerned. Since the appointment of the Nariman Committee of Enquiry into the affairs of the Bombay Development Department investigations would appear to be proceeding quietly. The resulting report ought to prove a useful document.

Calcutta Improvement Trust.—A scheme for the construction of Central Avenue and certain subsidiary roads between Grey Street and Shambazar Street is under the consideration of this Trust. Among other improvements it is proposed to convert the bustee land, bounded by Raja Nabakrishna Street on the north, Alignment No. XXI, as diverted, on the south, Central Avenue on the east and Raja Mahendranarayan Lane on the west, into a square measuring about 2½ bighas. With the exception of a belt 150 feet to 250 feet deep on Shambazar Street and a few pucca houses in Grey Street, practically the whole of the land on the west side of Central Avenue, as far as Sovabazar south of Raja Nabakrishna Street and for a depth of 360 feet north of the street, is bustee. The whole of this area has been included within the acquisition limits and 40 feet development roads have been provided in order to lay the area out in the most satisfactory manner.

Agricultural Operations in India.—The following facts are pointedly brought out by Mr. D. Clouston, Agricultural Adviser to the Government, in his latest report reviewing this subject. Out of a revenue of nearly Rs. 90 crores, the provincial departments of agriculture in India are spending little more than one per cent. on the development of agriculture while the net expenditure borne by the Central Government is only 0·07 per cent. of the total revenue. In other words the net expenditure of the Imperial and Provincial Departments of Agriculture works out at about 9 pies per acre of cultivated area, 8 pies per head of population in British India. The document is of special interest at present as far reaching changes in agricultural policy are likely to be announced shortly by the Linlithgow Commission. Mr. D. Clouston states that in the past agricultural departments have received most inadequate financial support and pleads for more money for research.

East Indian Railway.—At the last meeting of the Calcutta Advisory Committee of this Railway the members were informed that it was the policy of the Railway to speed up their mail and passenger train services as much as possible. They were able to do so to some extent in March 1927, but owing to the necessity for strengthening the bridges and culverts throughout the systems and in track repairs and in restrictions imposed through non-isolated stations, they had been compelled to decelerate and allow time for restrictions imposed in connection with the work mentioned which had resulted in the through running of trains generally being adversely affected. The longer period taken by the Imperial Indian Mail trains, and particularly those conveying inward mails was due to the Jubbulpore route having been closed owing to the bridge over the Nerbudda having been washed away in 1926, and the trains having to traverse an additional 97 miles *viâ* Katni-Bina and Itarsi. The Nerbudda bridge would be opened for traffic on 1st June. This would afford a much more convenient and accelerated service between Calcutta and Bombay as regards both the Imperial and Bombay Mail trains.

British Motor Boating Season.—The representative British motor boating journal, "The Motor Boat," issued their fitting out number on the 23rd of March, and we were interested to note how much busier British boat yards are this year compared with a similar period of 1927. It would appear, too, that a greater portion of new work is in hand for overseas shipment than is usual, and these cover a wide range of types. With the popularisation of the low priced little outboard craft, and the speeding standardised runabout craft equipped on bar lines, and the big influx of road motorists to the marine motorists ranks, the 1928 boating season will doubtless be the finest that has yet been known. While on the question of outboard engined craft, we would mention that British firms are preparing to meet this previously restricted market. The "Watermotor" has been available for some time, and now a Littlehampton firm, Messrs. Roness, Ltd., are making a big bid for the market. As the power unit of their output is being built by the J. A. P. of motor cycle fame, its success should be well assured. Additionally a four-stroke principle is employed which makes for better efficiency, silence and increased length of life, as compared with the two-stroke types, favoured by many of the American makers. The Roness is incidentally the only British twin outboard motor.

Colonel Lindbergh's City Plans £500,000 Airport.—St. Louis, the home town of Colonel Lindbergh, is to be one of the world's greatest airports, according to the engineer in charge of airport plans in St. Louis and Detroit. Speaking before the city club of

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The full and correct address should always be given on **Money-Order Coupons**—see instructions thereon.

St. Louis, the engineer compared the air to a great ocean. "The modern city without adequate aviation facilities is like a seaport town without wharves and docks," he said. "The air is the ocean of the future on which there will be a great and vital traffic." The development of St. Louis as an airport depends not only on the expenditure of from four to five hundred thousand pounds, but on intelligent foresight into the aviation needs of the future. "There are airplanes in daily use to-day," he said, "which weigh from five to seven tons. 'Planes of greater weight are coming soon, and these big 'planes require hard-surface runways for landing as well as taking off. The permanent, hard concrete surface that satisfactorily serves the fast moving motor vehicle on our roads to-day will also satisfactorily support the large airplane moving at high speed on an airport." A comprehensive plan for the St. Louis port is being prepared which includes permanent hangars, express and passenger stations, runways, markers, lights and other equipment. A somewhat similar airport is being projected for Detroit, funds for which have been made available up to £1,000,000. Incomplete figures for 1927 indicate that some 3,000 'planes were manufactured in the States and placed in use, exclusive of Government 'planes. It is estimated that this number will be trebled during 1928.

From the Grampians to the Alps.—A little two-year-old 12/40 Star two-seater car, with faded paintwork and without mechanical preparation, left its daily work in February last to take part in the great Monte Carlo Rally. It awoke no enthusiasm amongst the other competitors—in fact, its out-of-date coachwork met with much jocularity—but at the end of the run it was regarded with unmixed respect and not a little admiration. From John o' Groats to Monte Carlo is 1,500 miles, and in the Grampians were ice and snow and broken cart tracks. At Summit, the peak of a Highland chain, the jolting broke the junction of manifold and exhaust pipe, and the Star lay-to in a snowstorm. Having started an hour and a half behind the remainder of the competitors, the chances began to thin. At Dunkeld, the car lost its way, but after 24 hours of continuous running arrived in London before several of its rivals. In London, the owner went about his affairs to such an extent that the car missed the Channel boat and had to wait hours for another, finally arriving at the wrong port in France and having to run back along the coast to check in at the control. This put the little 'bus many hours behind, and its appearance had been far from improved by a collision with a road-chain in Dover harbour. But it took up the good work again, only to have the magneto peter out in a sea of rain and mud in Picardy. The very necessary screwdriver had apparently been left behind in the Grampians, and despite a spare magneto on board the chances began to grow slimmer than ever. A walk revealed a benighted garage, however, and in a couple of hours the Star resumed its way to Paris, where it arrived a good seven hours behind the crowd. But now both car and driver were on their mettle. Between Paris and Lyons the car gained 2½ hours on the fastest of all other cars engaged, and actually turned up fourth. At Avignon it stood well up, and after crossing the Esterel Mountains in the dead of night, a feat accomplished by no other car, for the precipitous hairpins are more than dangerous under such circumstances, the Star arrived at Monte three hours before time. It had accomplished 1,500 miles in three nights and three days, without even a valve adjustment, over roads that were in many places almost impassable, and formed one of the 47 survivors out of 73 entrants.

British Motor Imports and Exports.—It was during 1926, that motor exports from Great Britain for the first time exceeded motor imports in number and value. During that year nett imports, the number of which is arrived at by deducting re-exports from gross imports, amounted to 21,542, this figure representing the total of private cars, commercial vehicles and bare chassis. The revised figure for exports during 1926 showed a total of 32,388. The exports of complete cars exceeded the imports by about two thousand, and the exports of chassis exceeded the imports by upwards of 6,000. As regards commercial vehicles, the figures were smaller, but exports were very nearly double imports in number and more than five times as great in value. In other words, under this heading imports must have consisted mainly of quite light vehicles of small value, while exports must have consisted mainly of quite substantial vehicles of substantial value. During that year, the value of total exports exceeded the value of imports by well over four million pounds. We may now consider the corresponding figures for 1927. In some respects, these are more, and in other respects less, satisfactory. Total exports increased as compared with the previous year, both numerically and in value, and exports also increased under all the three headings of cars, commercial vehicles, and chassis. Total exports amounted to 35,696, that is to say, an increase of over three thousand. Their value showed an increase of not much less than a million pounds, which means that the average value of each export was larger than in the previous year. Meanwhile, imports also increased; total nett imports for the year numbered 31,375 to a total value of about £4,900,000. Thus the margin of exports over imports as regards numbers was only about 4,300 instead of being upwards of 10,000. The margin in respect of value was about three and a half million pounds as compared with over four million pounds. Under one heading, namely, complete private cars, imports exceeded exports in number but not in value. Under the other headings, exports exceeded imports in all ways. The figures show a remarkable ascendency on the commercial side of the British Industry; in this group the imports only amounted to about one hundred vehicles, valued in all at less than £19,000. Meanwhile, exports amounted to 1,737 vehicles, with a total value of well over a million pounds, the average value of exports being much higher than in the previous year. The total value of exports is substantially greater than it has ever been in any past year, but exports during the last half of the year did not compare favourably with exports during the first half. Over 21,000 vehicles went out during the first six months, the figure for the last six months of the year being somewhat under 15,000. One cannot, however, deduce very much from this fact since it may quite possibly be found that exports for the first months of 1928 will be particularly large, bringing the recent average up to a quite satisfactory figure.

Current News.

A GRAIN elevator with a capacity of 1,000,000 bushels is to be erected at Toronto.

MR. A. M. GREEN is appointed to be a member, Board of Trustees, Bombay Port.

IT is proposed to build a bridge across the Liao-ho at Newchang Station on the Peking-Mukden Railway.

THE Baghdad Corporation is engaged in considering the proposal of constructing a new city in the suburbs of Baghdad.

THE equipment of 500 looms at the Shen Sing No. 3 cotton mill at Wusih, China, has been extended by the addition of 400 more looms.

MR. E. A. SMYTHIRS, officiating Conservator of Forests, United Provinces, is appointed to take charge of the working plan of the circle.

A PAPER mill at Shanghai is utilising the reeds, which grow in profusion along the river banks, as raw material. Its capacity is about 45,000 reams a year.

MR. A. E. OSMASTON, officiating Conservator of Forests, United Provinces, in charge of the working plan of the circle, is transferred to the Eastern Circle.

THE Railway Board have sanctioned the survey by the East Indian Railway, for a line from Allahabad to Sirathu *viâ* Sarai Akhil and Manjhanpur, a distance of 43 miles.

THE Calcutta Tramways Company's new line along Main Sewer Road will be opened on 8th June. Mr. B. K. Basu, Mayor of Calcutta, will perform the opening ceremony.

THE United States Government proposes to extract helium gas from the natural gas of the oil wells at Amarillo, Texas, by means of a special plant put up there for the purpose.

MR. R. W. TARGETT, Deputy Director of Purchase, Stores Department, is appointed to officiate as Director of Purchase and Intelligence, *vice* Lieutenant-Colonel H. M. Alexander.

THE total approximate gross earnings of State railways up to 12th May amounted to Rs. 13·09 crores, or Rs. 63,00,000 more than the figures for the corresponding period of the previous year.

MR. F. CANNING, officiating Chief Conservator of Forests, United Provinces, is to hold charge of the Forest Engineering Division in addition to his own duties, *vice* Mr. F. R. R. Channer, who has been granted leave.

THE total number of kilowatt-hours sold by the Shanghai Municipal Electricity Department during the year 1927 was 400,343,385. The capacity of the plant is 121,000 kw. The department employs 3,191 Chinese.

THE total approximate gross earnings of State railways for the week ended 12th May amounted to Rs. 21,00,000 which is the same as in the last week, but Rs. 11,00,000 more than the figures for the corresponding week of the previous year.

A NEW shaft-sinking record has been established in South Africa at the Springs Mines' No. 4 vertical shaft. During March three shifts consisting of a sinker and helper and a gang of forty-two boys, working thirty-one days with Ingersoll-Rand drills, sank 286 feet.

THE Khanaqin Oil Company Limited, a subsidiary of the Anglo-Persian Oil Company, has brought in two further wells with a production of 140,000 gallons and 300,000 gallons a day, respectively, in the Iraq sector of the Naftkhana fields. Both wells are under control.

THE Calcutta Electric Supply Corporation, Ltd., have been granted a licence by the Government for the installation of electric lights in Serampore. The work, it is understood, will be taken up from July next and the installation is likely to be completed within a year.

THE members of the Institution of Locomotive Engineers (London) are proposing to visit Cologne, Cassel and Berlin to inspect some of the principal works relating to railways in these cities. It is intended to leave London on the evening of 9th June and to return on 17th June.

THE Peking-Mukden Railway Administration is contemplating the construction of double tracks on the Tientsin-Shanhaikwan section of the line, and has obtained the approval of the Ministry of Communications. Construction work will begin as soon as a definite plan has been formulated and the necessary funds raised.

AN area of 45,850 square miles, larger than the whole of Cuba, was photographed in Canada from the air in 1927, by the Royal Canadian Air Force, for the Topographical Survey Branch, Department of the Interior. Photographs of this wide stretch of territory, taken for map making and other purposes, numbered 62,586. Of the 45,850 square miles, 26,650 square miles were photographed obliquely and 17,200 square miles by vertical photography. The oblique photographs taken numbered 6,1246, and the vertical 46,340.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

THE P. K. FORMULA.

SIR,—May I be permitted to state the case for application of the above formula to all irrigation channels in a few words?

Assume that the *maximum* discharge in any such channel requires a mean velocity of V_o^1; and that the *minimum* discharge, to carry all silt, should be $V_o = C_o\sqrt{m_p}$. It is obvious that the maximum $V_o^1 = C_o^1\sqrt{m_p}$.

It follows that the practical way of dealing with the problem is to line the channel with watertight material, which when scoured clean of all silt-deposit will stand easily the velocities V_o^1 at any varying depth. The velocities V_o will ensure the full values of m_p, at all times.

Σ. φ.

3rd May 1928.

INDUSTRIAL UNREST.

SIR,—Although I know you ban anything in the way of politics may I be permitted to make a few remarks on the subject of Industrial Unrest. Owing to the many changes which are taking place the world over, it is not surprising that India should also be affected. Certain parties, who may be termed "Wreckers" for short, are busily employed in causing disaffection amongst workers in industrial concerns with which they have nothing to do. The spirit of mischief is broadcast. The industrial workers are persuaded to strike and leave their work, promises of great improvement in their condition being made. The workers are promised great things and are persuaded to believe that they will be made good if they will only hold out long enough for the promises to be fulfilled. The ignorant workers place implicit trust in the promises made and go on strike only to find out their mistake later on. The war is between Capital and Labour. The capitalists are blamed for being at the bottom of all the trouble. But for capital all industrial concerns would come to a standstill. The Governments concerned know that the efforts of the wreckers is but a passing show and that their policy will not hold water, so they take no notice of their tactics. The wreckers are constantly complaining that not enough is being done to encourage industry, whilst what is being done is assailed and efforts are being made by the wreckers to undo what has been done and is being done. The attempt to dislocate the working of railways is a case in point, and yet without railways what would the public do. The railways, however, draw up the five years' programmes for extensions regardless of the wreckers. The Railway Administrations full well know what they are about and take no heed of the efforts of the wreckers to wreck them. So with all other industrial concerns, they go on their own way, knowing full well that though inconvenienced for a short time that in the end they will come into their own. The attempt made by the wreckers to put a stop to progress is bound in the long run to end in failure, but it is a pity that such attempts are being made for it harms the country for a time. The poor ignorant workers are the greatest sufferers. In some cases they lose their jobs and are then ruined and reduced to beggary. They are greatly to be pitied. Industrial concerns, whether Government or otherwise, are not philanthropic, they must show a certain profit on the capital invested or go into liquidation. Business concerns cannot be run on lines which do not meet all contingencies, it would not be business. Capitalists do not invest in ventures which can show no profit. Money makes money, and in cases in which it does not it is rightfully neglected. No business that does not pay its way can hope to stand. The wave of Industrial Unrest passing over India at present will sooner or later come to rest and then a brighter day will dawn and progress proceed for the benefit of the whole country. India needs to progress otherwise she will not be able to claim a place amongst progressive countries which are striving to better their conditions by all the means in their power. All said and done Industrial Unrest is but a passing cloud which will blow over in course of time and which need not be taken too seriously. Those who love India and wish to see it prosper cannot fall in line with those who oppose all progress.

A LOVER OF INDIA.

Foreign Notes.

The Plougastel Bridge.—The longest and most important armoured concrete bridge yet constructed in France is that which will cross the mouth of the river Elorne between Brest and Plougastel. The bridge will have three spans across the river, each of 180 m., and with the approaches will have a total length of 1,200 m. It will carry a roadway, tramway and railway one above the other. The concrete abutments have been completed and the wood frame for the arch was constructed close to the shore with the ends resting on concrete barges. Recently the frame, which has a width of 10 m. and weighs 540 tons, was successfully moved by means of windlasses into position for the construction of the first span. It is expected that the bridge will be completed in about eighteen months.

New Persian Railways.—The recent general meeting of the Shareholders of the German company, Julius Berger Tiefbau A. G., of Berlin, has sanctioned an arrangement under which a railway line is to be built for the Persian Government from Bushire, on the Persian Gulf, through Ispahan and Teheran to Amul, on the Caspian Sea, with branches. The following firms are said to be interested in the scheme: Ulen and Company, New York; J. G. White Engineering Corporation, of New York; Stewart and McDonnell, public works contractors. of London; the Julius Berger Company, of Berlin; Philip Holzman. of Frankfurt-on-Main; the Siemens Bau Union, of Berlin; and the French Batignoles Company. The amount involved in building the trunk line and various branches is estimated at £16,000,000.

An Historic Dock put to a New Use.—The old dock at the Camber, Portsmouth, which has been used as a dry dock for very many years, is soon to be put to new uses. The Portsmouth City Council, at its last meeting, accepted a tender for alterations, including the provision of a new caisson and the lowering of the sill of the dock, which, when completed, will admit of steamers of 1,000 tons capacity being berthed. The dock was taken over by the Electricity Committee in connection with a greatly extended scheme of coal-handling plant. Colliers will be berthed and by means of the new plant rapidly unloaded, and the coal will be conveyed direct to the generating station, which is situated but a short distance from the dock. The unloading will be undertaken at the rate of 100 tons an hour in order to ensure the dispatch of the vessel on the next high tide.

Treatment of Mine Timber.—Instances have been reported to the U. S. Bureau of Mines in which mining companies have tried treated timber and have had indifferent success, if not absolute failure, but from close observation of the operating methods at some mines the reason for this lack of success was readily apparent. It seems to be the custom at these operations to turn the timber treatment over, without adequate supervision, to a yard foreman, or in some cases to an ordinary labourer, who had neither interest in the subject nor any knowledge of it. As a result, in many instances green timber is treated, the periods and time of treatment are irregular, no regular analysis of the preservative is made or even a preservative quite unfit may be used. It cannot be emphasised too strongly that to obtain successful results the timber must be properly seasoned and scientifically treated with the right kind of preservative under intelligent supervision.

Motor Vehicles in Iraq.—According to the figures quoted in a report received recently, from the authorities in Iraq, regarding the motor vehicles registered in that area during the month of December 1927, it would seem that this possible market for vehicles manufactured in Great Britain is not being worked with any degree of thoroughness. The products of only four well-known English firms are included, each firm having supplied one vehicle. The total number of vehicles registered during this particular month was 92, about twenty different makes being represented. The Ford touring model heads the list as favourite; 22 of these were registered, in addition to five other types of vehicle; Chevrolet comes second with 19 motor-cars and nine lorries. The majority of the trade is in the hands of American firms, and it is essential to success that British firms should understand the conditions under which the cars are called upon to operate, and to design both chassis and engine to meet the requirements of the locality.

Barrage Reservoirs.—The failure of dams in North Africa and in the United States and the recent warnings of Monsieur Mesnager, the well-known expert on hydraulic constructions, have given rise to some nervousness about the safety of the barrage reservoirs which the Municipal Council of Paris intends to construct at Panèssiere and Champaubert-aux-Bois in order to regulate the level of the Seine and minimise risk of flood. Those barrages provide for an overflow of one-quarter of the maximum volume of the reservoirs, and it was feared that that would be insufficient, since greater volumes of water might have to be dealt with; but in an official statement just made it is affirmed that the possible maximum volumes of the rivers in this country are so well known that there can be no risk of exceptional pressure on the dams, particularly in view of the fact that sufficient margin is allowed for every contingency. In view of recent warnings a good deal of caution is now being exercised in the preparation of plans for the many barrages which are to be constructed in this country in the early future.

Carbon Dioxide for Fighting Mine Fires.—Many attempts have been made to use carbon dioxide in fighting mine fires by introducing it behind seals. More recently, carbon dioxide snow has been proposed for fighting a fire directly. In some of the earlier attempts to employ carbon dioxide behind stoppings, as at the Engleville mine in Colorado, about 25 years ago, the carbon dioxide was made at the mouth of the mine by sulphuric acid applied to limestone in water in closed vats, and was blown through a pipe that extended through the fire stopping. At the Engleville mine the attempt failed because breaks in the strata over old workings extended to the surface, and the area could not be sealed tight. At other mine fires tanks of liquid carbon dioxide have been used. The only advantage from the use of carbon dioxide is that the pressure created by moving the gas into a fire area tends to keep external air from entering if the ground is so broken that the sealing cannot be made tight. When the seals are reasonably tight, the rapid absorption of oxygen by the coal makes the use of carbon dioxide unnecessary.

The Makhonine Fuel.—Since the failure of the Russian engineer, Monsieur Makhonine, to launch his apparatus which was to be fitted to heavy motor vehicles for producing spirit direct from heavy oils, he has turned his attention to a new fuel intended specially for aviation and marine engines. He claims that his fuel is uninflammable and is capable of much higher compressions than petrol, with the result that while being perfectly safe it gives a much wider range of action to aeroplanes for a given quantity of fuel. For a year past tests have been carried out in the navy, and some months ago the Minister of Marine announced that the tests had revealed serious defects in the fuel. Under pressure of a section of the Chamber of Deputies it was decided to continue the tests in the air service, and, apparently, the difficulties referred to have been overcome, for it is stated that the trials at Villacoublay have been entirely satisfactory. The engines ran from thirty-one to forty hours, but while the results are declared to be good they can hardly be accepted as conclusive in view of the failure of the heavy oil refining apparatus after it was officially stated to have come triumphantly through tests on military tractors and lorries.

The Southampton Docks Extension.—For the last year or so the Southern Railway Company has been engaged on part of the reclamation scheme in connection with the extension of the Southampton Docks, which lies between Millbrook Station and the Royal Pier—an area of about 18 acres, says the "Engineer." It has now been decided to proceed with further work, and the contract has been let to the James Dredging, Towage and Transport Company, which has carried out the preliminary work mentioned above. The new contract includes the dredging to a depth of 35 feet below L. W. O. S. T. of an approach channel, wherein will be the swinging ground for vessels proceeding to or from the new jetties. About 10,000,000 tons of spoil will be dredged, of which about 7,000,000 tons will be used in further reclamation. The remainder, consisting of soft mud, will be taken to sea. A main bank, 150 feet or so wide on the top, is to be made on the southern, or seaward, side of the reclaimed area, on which, as part of a subsequent contract, will be constructed the quay wall of the new jetties. The spoil will be dredged by bucket ladder dredgers into barges, which will take it to the site required, and there a special bank-building vessel will raise it by means of a bucket elevator and place it in position. The work will take about four years to complete, and will be carried out to plans and specifications prepared by Mr. F. L. Wentworth Sheilds, M. Inst. C. E., the railway company's dock engineer.

Railway Facilities in Southern Rhodesia.—The announcement by the British Engineers' Association that Dorman, Long and Co., Ltd., have secured the contract for the new Limpopo bridge in Southern Rhodesia is an assurance of the speedy development of railway facilities in that area, says the "Railway Gazette." The new bridge, which is being provided at the cost of the Beit Railway Trustees, will carry road as well as railway traffic, and will consist of 14 spans each of approximately 100 feet which are to be built in this country and shipped to Rhodesia in sections. In connection with the construction, the South African Railways are to be extended from Messina to a point some six miles into Southern Rhodesia, and arrangements have been made for this line to be worked by the South African Railways Administration for a period. This, incidentally, will be the first Government-owned line in Southern Rhodesia. The nearest point on the Rhodesian railway system is West Nicholson, whence connection is made with Bulawayo and Beira *viâ* Heany Junction. A considerable mileage of new railway is to be built to connect West Nicholson and Messina *viâ* the new bridge, and so effect a second through means of railway communication between Rhodesia and South Africa. Work on the new line is to be expedited, as the new route—there is no gauge difficulty—will not only be more direct for Pretoria, Johannesburg and other places, but in Southern Rhodesia will open up a vast area capable of intensive development. The Rhodesian railway system at present comprises 462 miles of 3 feet 6-inch gauge lines, is owned by six companies and passes through five distinct territories.

A New Thames Bridge Scheme.—The "Engineer" says that in November last Colonel Ashley, the Minister of Transport, asked Messrs. Mott, Hay and Anderson, of Westminster, in co-operation with Sir George Humphreys, the chief engineer of the London County Council, and Mr. A. W. Szlumper, the chief engineer of the Southern Railway, to prepare a report on the cost of the double-deck bridge at Charing Cross, the construction of which was proposed by the Royal Commission on Cross River Traffic, presided over by Lord Lee. That report, which has new been placed before the Prime Minister, makes, we understand, an important alternative proposal which embodies a fresh scheme. The basis of the new proposal is that the existing Charing Cross Station should be removed from its present site, and that Waterloo Station should be greatly extended in order to cope with the Charing Cross station traffic. The present railway bridge and the Hungerford Bridge should, it is proposed, be demolished, and in their place a new road bridge be constructed, which would connect Waterloo Road with a point near to the Nurse Cavell Statue. Waterloo Bridge could be retained, but it would be widened to take four lines of traffic. With regard to the cost of a double-decked steel bridge at Charing Cross, which formed part of the Royal Commission's recommendation, it is understood that the engineers, although they do not find that the constructional difficulties involved in building such a bridge are insurmountable, are unable to accept the estimate of expenditure of £7,500,000, which was put forward by the Commission. They estimate that Lord Lee's scheme would entail an expenditure of from £11,000,000 to £11,500,000, and on this ground they do not see their way to accept that proposal. The alternative scheme which we have outlined is put forward with a view to obtaining equally good cross-river traffic facilities at a less cost. It is expected that the Government will, in the near future, give a decision on this important matter, and that the new scheme will be recommended for consideration by the authorities concerned.

General Articles.

MODERN FLEXIBLE PIPE JOINTS.

A STRIKING INSTALLATION FOR SEWERAGE AND SEWAGE DISPOSAL.

FURTHER in connection with flexible pipe joints, another characteristic example of the value of this principle is represented by a pipe line scheme, of which we are able to give several photographs on the opposite page, recently installed in Great Britain, for the Brimington, Staveley and Sutton-cum-Duckmanton Joint Sewerage and Sewage Disposal Scheme in Derbyshire, the Engineer Surveyor being Mr. Harold Taylor, A. M. Inst. C. E.

In this case the pipe is laid over soft marshy ground of the most difficult character on lines that would have been quite impossible with the ordinary rigid pipe joint. It may be stated that several years ago Mr. Taylor installed a 9-inch "Victaulic" pipe line for sewage, which has given excellent results, and accordingly for the above installation the same method has been adopted, the pipe line being in the open air, fixed on small concrete pillars, and in fact the ground is so bad that a number of these pillars have sunk to a considerable extent, although special precautions were taken to try and prevent this. However, the operation of the joints is not affected, and there has been no trace of leakage, or other trouble in spite of the bending shown in the photographs.

The pipes used are of cast iron, British Engineering Standards Class B, varying in sizes from 4 inches to 27 inches bore, although the major portion of the equipment is over 12 inches bore. There have been fitted 1,200 "Victaulic" joints, having housings of malleable cast iron with a tensile strength of 22/24 tons and minimum elongation of 6 per cent. on a Brtish Standard Test Bar, material of this character being able to stand a very considerable amount of stress.

The general principle of the "Victaulic" joint, it will be remembered, is that the pipes are made with a straight lip or rim at each end, and round this there is fixed a heavy rubber composition ring bent almost double, having round the outside a housing ring bolted on generally of alloy steel. The higher the pressure the tighter becomes the joint, while the resistance of this ring is so great that it is superior to the steel pipe itself. Thus, for example, many experiments have been carried out by actually bursting lengths of pipe under enormous hydraulic pressure, when the rings are not affected, and it is also an unquestionable fact that the life of the ring will be as long as the steel pipes, as shown for example by the ordinary common flanged joints with rubber rings on gas pipes that have been taken up after 50 years when they are still as good as ever although not protected in any way from the soil by the housing ring as in the case of the "Victaulic" joint.

ROADS IN BARODA.*

PROGRAMME OF FUTURE CONSTRUCTION.

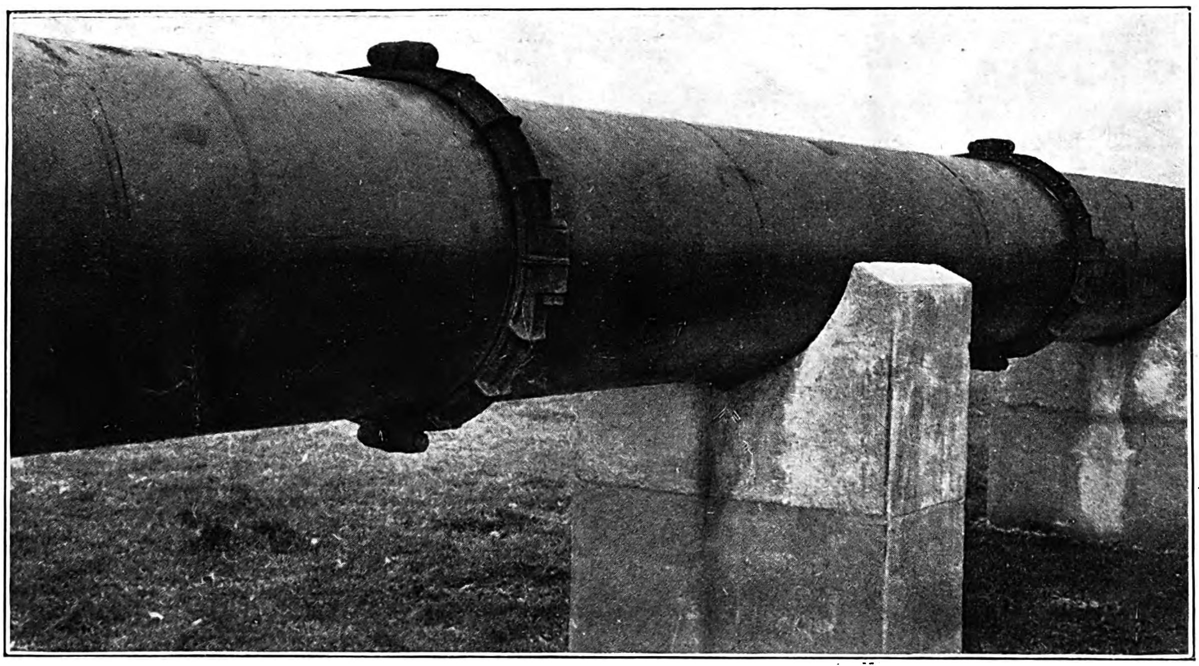
By S. K. GURTU, Chief Engineer, P. W. D., Baroda.

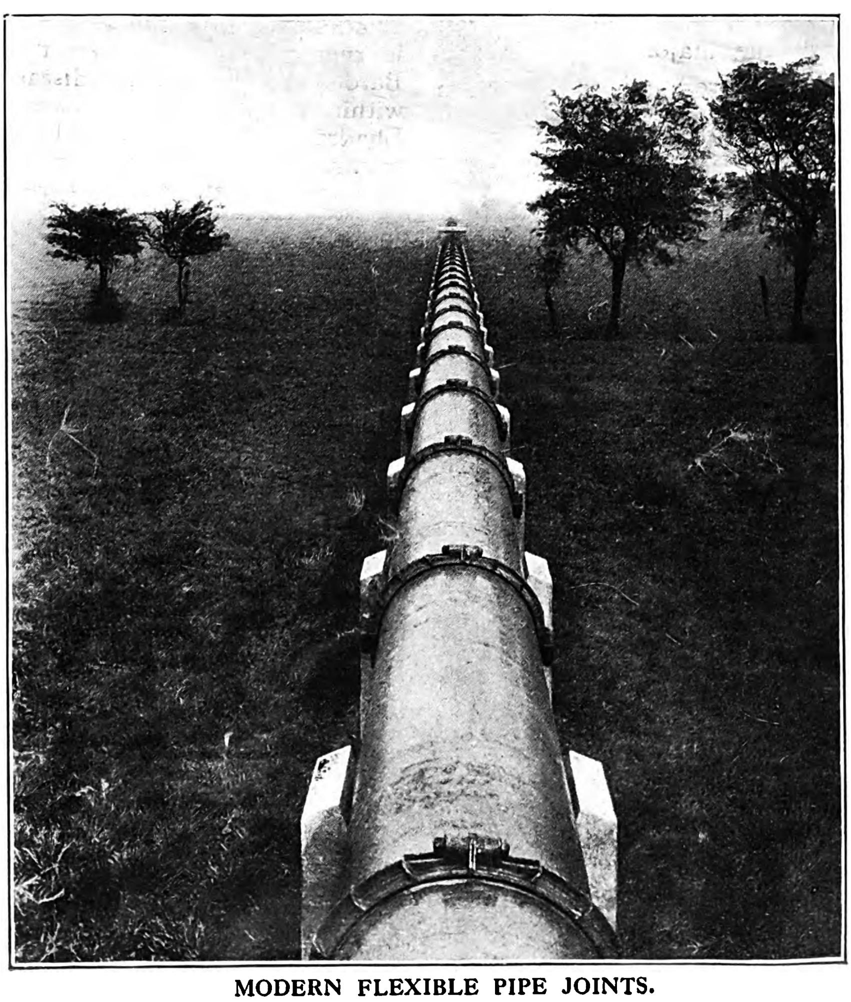
MODERN civilization depends on its continuance and advancement on the facilities of transport. It will have been observed that those nations alone have come to the fore who have perfected their systems of transport. Not content with electric Railways and first class roads, the European nations have gone to the air to increase their transport facilities. It does not, therefore, require labouring that on transport facilities the development of the natural resources of all States depends, and Baroda is no exception to this economic law.

2. I am sometimes surprised to see people put forward the so-called rival claims of Roads and Railways. There is no question of rivalry between the two; both are useful and necessary institutions. We may as well consider the rival claims of hands and feet. Hands are necessary and indispensable in the human organism and all that can be said in their favour is correct, but so are feet. What can hands do, if the absence of feet makes locomotion impossible? Similarly there is no rivalry between Railways and Roads—both are absolutely necessary in civilized life and are supplementary to each other. Railways cannot take up the function of roads, nor the roads, of railways. Can the addition of two more hands, to pursue the above analogy, make up for the absence of two feet? No. Nor can over-multiplication of Railways make up for want of roads. Some time ago I was reading about the "battle of gauges," in the Minutes of the Institute of Civil Engineers. In the discussion Mr. Royal-Dawson deprecated the change of gauges and strongly advocated their uniformity for India, as much valuable time was wasted by changes and transhipment, due to difference in gauges. *A fortiori*, the absence of any connection between various centres of activity in the mofussil by roads, militates against inter-communication and development of traffic. Take a concrete example; going to Bhadran we have to entrain at Baroda, change at Anand and Petlad and arrive in Bhadran, after wasting more than 5 hours in the journey. If there were direct communication between Baroda and Bhadran the distance could be negotiated within an hour. If this were possible how rapidly Bhadran will grow; similarly other important district towns. Time is money and for the internal development of the districts, roads are a *sine qua non*. Where time is no consideration and heavy material is to be transported long distances, railways are necessary and will always be in requisition for this purpose, but they are bound to be replaced by aircraft and roads, during the next 25 years, for all light traffic and speedy locomotion. This is as clear as daylight.

3. In his address to the Indian Railway Conference Association Sir Clement Hindley, Chief Commissioner, Railways (INDIAN ENGINEERING of 22nd October 1927) urged the encouragement of Road Development in the following words:—"There has been recently a conference of Provincial Representatives to consider the matter. This subject is going to be very actively pursued probably by means of a Committee, which will shortly be appointed by the Government to investigate the matter in various parts of the country. I hope that it will be possible for the Agents of Railways, and for some of their officers to give evidence before that Committee during the coming cold weather. I have asked that Agents should be invited to give evidence, and I want you to remember one or two things in connection with that. We as Railway people might *primâ facie* be considered to be opposed to a larger development of road motor transport. I do think that we ought to have a uniform policy in regard to that because *this movement for road development, as*

* Technical Paper Series, No. IX, Progress Report of Roads in Baroda.





MODERN FLEXIBLE PIPE JOINTS.

I have mentioned to some of you before, is going to be a very live and a very important thing, and our only hope of helping our own business, and that of the country generally, is in formulating a policy which will chime in with the policy of road development. I would ask you to very seriously consider what evidence you are going to give to that Committee, and what your attitude is to be. Broadly speaking we ought to be in favour of encouraging *every possible form of transportation in the country, although at certain places and in certain parts of the country it may come into competition with us, yet looking at it broadly the improved methods of transportation that may be involved will assist us ultimately in obtaining* more traffic and more business. It will help us to work more effectively for the development of the country."

4. It is not possible to construct direct Railway routes between all important centres owing to heavy cost of capital and maintenance but all trade and industrial centres must be connected by roads as is the case in Europe and America. 90 per cent. of the Baroda mofussil land remains impassable in the wet months and traffic is absolutely stopped. Railways doubtless make traffic possible between very few important centres, where they touch, but from June to October the village life all over the State is in a sort of suspended animation; even country carts are not available; and all activities cease, *i. e.*, for four months in the year the villagers go to sleep or are in hyber-nation, as it were. Is this right? Is this economically sound? No. The energy which is represented by millions of unemployed hands and cattle during the wet months is an economic waste and must be obviated and this is only possible if the interior is opened up by metalled roads, cottage industries encouraged, and the benefits of civilization brought within the easy reach of villagers.

5. I am aware that the task of connecting Baroda district townships with each other and the Capital is beset with many difficulties, the most notable of which are :—

(1) Excessive capital cost of construction, due to abnormally high rates—partly due to economic causes and partly to absence of free competition among contractors. Too much stress is being laid on giving work to local men and shutting off outside competition, which tends to keep down rates.

(2) Heavy cost of maintenance.

(3) Scattered nature of the different parts of the Baroda State, which makes it difficult to connect two centres of industry, owing to intervention of foreign territory, leading to many political complications.

(4) Absence of direct income from roads, *vis-a-vis* the Railways.

These do, in a great measure, explain the poorness of the road programme in the past and account for the rapid programme of railway construction, but, in my view, time has arrived when even the Railways are beginning to suffer for want of feeders. What will Railways carry if the feeders are not there to bring the grist? In undertaking any big Railway project, in all civilized countries, it is customary to provide feeders simultaneously, in the shape of tramways, light railways and roads, and invariably an intensive railway programme results in a rapid road programme. It should have been the same in Baroda, if things were normal, the administrative and economic necessities of roads were realized and the fact of railways paying 3 to 4 per cent. were not made the determining factor. I can say, without any fear of challenge, that the income of our existing and projected railways will get greatly ncreased if feeder roads are constructed joining up railways with the interior and conversely, if railway construction is pushed, at the expense of roads, the income of railway will fall off.

6. The total mileage of fair-weather and metalled roads of the Baroda State is 917 miles (482 fair-weather and 435 metalled roads.) The next ten years' programme contemplates the construction of 349 further miles (56 fair-weather and 293 metalled roads) but the slow way in which road projects move it is likely to take more than 15 years for this programme to be complete. In my view this programme is much too slow for the requirements of our enlightened State and the growing needs of the people.

In the late rains when the whole district life was disorganized by the flooding of the country and the breaches of the railways, Waghodia, so near Baroda, was isolated and its food wants could not be relieved, for a time, owing to the absence of road communication. This is a sad commentary on the efficiency of our road system.

It may also be noted that if work on roads in different Districts is carried on systematically it will find employment for thousands of people in years of scarcity and would obviate the need of relief works.

I trust the considerations that I have set forth above, briefly, will induce the Government to be a little more liberal in granting funds for roads.

7. After these preliminary remarks on the *raison d'être* of roads in the economic life of the country, I shall give briefly a *resumé* of road operations in the past and contemplated programme in the future, according to the orders of the Huzur and the settled policy of the Government.

History of Road Construction.

8. Construction of new roads was going on till 1907 in a perfunctory manner. The Local Boards constructed small lengths, after consulting the Revenue and the Forest Departments, where urgent necessity for same was felt. Till 1907, 456 miles of roads were constructed at an approximate cost of Rs. 37,62,000.

His Highness the Maharaja Saheb visited the Navsari District in 1907 and the necessity of making more roads was brought to his notice by the Suba Navsari District. After considering the amount spent and the cost of maintenance His Highness was pleased to order to draw up a new programme of roads to be constructed according to necessity. A tippan was submitted by the Suba, in consultation with the P. W. D., showing the necessity of spending Rs. 13,23,734 for urgent roads, amounting to Rs. 7,41,784 and for unimportant ones amounting to Rs. 5,81,950 or so. On this His Highness the Maharaja Saheb was pleased to order that a sum of Rs. 1,00,000 should be provided for the Navsari District alone (this amount was increased to Rs. 1,25,000, after three years) for a period of five years. Similar programmes were ordered to be drawn up for other districts.

9. Proposals, showing the necessity of spending Rs. 39,83,585 to improve the old roads and constructing new ones urgently wanted, having been submitted for Baroda District, the Huzur was pleased to order to spend every year Rs. 1,00,000 for a period of five years. Further proposals were, later, made by the Chief Engineer (on 2nd January 1913) showing the necessity of constructing new roads in the Kadi District, at an estimated cost of Rs. 21,12,000. It was proposed that Rs. 50,000 should be allotted every year. As the Kadi District has got a good net work of Railways, branching off in all directions, this proposal was negatived and it was laid down that approach roads to Railway stations and roads that were necessary for places of pilgrimage such as Unawa, Modhera, etc., should only be taken in hand. Details of same having been worked out with the help of the Sar Suba were submitted to and approved by the Honourable Council, allotting Rs. 50,000 every year.

10. Similar proposals were submitted by the Chief Engineer for the Amreli District, showing the necessity

of spending Rs. 3,66,641. Important roads were put in hand and many of them were nearly completed. There were some murum roads too which required improvement. Proposals in respect of same were sanctioned, allotting Rs. 25,000 every year.

The total amount to be provided rose to Rs. 3,00,000 per year for a period of five years, from 1913 to 1918.

This amount of Rs. 3,00,000 per year could not be made available after 1919 or so, on the termination of war and general retrenchment.

11. Up till 1926, 435 miles of metalled roads and 432 miles of fair-weather roads were constructed at a total approximate cost of Rs. 70,74,000 excluding the amount of thorough repairs. Every year about Rs. 1,24,000 are provided for annual maintenance.

12. A new road programme was, later, submitted to the Government after consulting the three Subas, *viz.*, Baroda, Kadi and Navsari. The Amreli Division had already 296 miles of metalled roads and 120 miles of murum roads. The Committee appointed to consider this did not think it necessary to push the Amreli programme, hence nothing was done, regarding extending roads in Amreli.

The total length of the metalled roads proposed was 293 miles costing Rs. 51,62,500, and 56 miles fair-weather roads costing Rs. 2,52,000, thus making in all Rs. 54,14,500.

13. As per Council Order every year three roads are to be started in consultation with Suba of each District and the Manager and Engineer-in-Chief for Railways.

The following roads are proposed for the Baroda District :—

1. Road from Baroda to Kherwadi *viâ* Waghodia.
2. Road from Baroda to Asoj *viâ* Jarod. *
3. Road from Baroda to Sunderpura, etc., to link up with Sinor.

For the Kadi District roads proposed are as below :—

1. Road from Pattan to Bechraji with culverts.
2. Road from Dehgam to Attarsumba with bridge and culverts.
3. Road from Visnagar to Vijapur.

The Navsari District programme is as below :—

1. Chalthan Kholwad Road.
2. Mahuwa Nihali Road.
3. Mangrol to Nani Naroli to meet Kim Mandvi Road.

We are now to start work on roads in consultation with the Communication Board after making provision of Rs. 5,00,000 in the budget every year, for a period of ten years. Slow as this programme is it should not be cut for any but the most paramount considerations.

14. The Railway Department has sent in notes with regard to the order in which different roads are to be started according to their point of view. Their views differ from the recommendations of the Subas and the Executive Engineers which are based on more general considerations and in view of the requirements of the districts. Necessarily the views of the Railway Department are based on the view that roads are subservient to Railways. This may be sound as far as the Railways are concerned but, in my view, administrative considerations should be given precedence over mere financial or departmental considerations and wherever possible both should be combined.

ROAD CESS (TOLL).

15. The question of levying toll on roads was considered in the meeting of the Communication Board held on 19th January 1928 and it was considered desirable to collect toll on roads open to heavy motor and wheel traffic, as it was necessary to construct such roads with a thick soling of rubble instead of brick-bats and a harder surface metal than kunker or brick ballast, as a soft material like brickbat cannot withstand the heavy gride of loaded and rapidly moving lorries. Recently in the case of Baroda-Chhani Road which was originally constructed for light wheel traffic, the question of levying toll was mooted when motors began to ply on this road. The Government in their Resolution No. 35-12 dated 2nd September 1927 sanctioned the following scale :—

Motor 'buses ...	... Rs. 15-0 per month.
Motor cars ...	... " 7-8 " "

16. It was suggested to charge Rs. 30 per month for motor lorries but in view of thin coat of metal, the Government interdicted lorries being allowed to go over the Baroda-Chhani Road.

17. In order to reimburse the Government, in part, for heavy expenditure on road maintenance, the following scale is suggested to be levied from all wheel traffic over all the State Roads :—

LICENSED WHEEL TRAFFIC.

Motor lorries ...	Rs. 30-0 per month.
Motor 'buses ...	" 15-0 " "
Motor cars ...	" 7-8 " "

STRAY WHEEL TRAFFIC.

	per trip (going and coming). Rs.	As.	P.
Motor lorries	1	0	0
Motor 'buses	0	8	0
Motor cars	0	4	0
Country carts, loaded	0	2	0

18. This is a light charge and may be tried tentatively on all State roads.

19. No motor traffic will be permitted on fair-weather roads but stray touring cars and cart traffic will be allowed free.

* The work on this has just been started.

ROHTAK-PANIPAT RAILWAY LINE, OPENED.

SIR MALCOLM HAILEY, the Governor of the Punjab, performed the opening ceremony of this new line of railway in the South-Eastern Punjab on the 14th May at Rohtak.

Colonel Walton, Agent of the North Western Railway, gave a brief history of the new line, which will open up much valuable country in the centre of which is the old town of Gohana in the canal irrigated areas of Rohtak and Karnal districts.

His Excellency the Governor said it was fortunate that the programme of railway expansion was widespread. Kangra, Sheikhupura, Amritsar, Sialkot, Gurdaspur, Jhang and Lyallpur had each had a share of new lines and now Rohtak and Karnal were added to the list. This last line opened up an area that was frequently hard hit by scarcity. Dating from the great scourge of 1840 there had been 12 recorded periods of drought, the last two in 1899-1900 and 1905-1906. In the former the railway had brought in 19 lakhs of maunds of food and in the second, which affected the cattle of the Rohtak Jats in particular, it had carried in vast quantities of *bhusa* at concession rates.

Rohtak district stood third in the Punjab in respect of the number of combatants contributed to the ranks of the army during the Great War and a Jat regiment was among those allowed to bear the Royal title at the end of the war.

The Jats had moreover shown great public spirit and self-sacrifice in their sincere efforts to improve their civil condition.

"I know that we have only touched the fringe," continued His Excellency. "India has only one mile of railway for 46½ square miles of its area. But the efforts now being made to increase our mileage are an earnest of fresh advance to come. We have been told to-day that in the last two years the North Western Railway Survey Division, under Mr. F. S. Bond, the Deputy Chief Engineer, has surveyed 3,000 miles of line. Not all the projects, which they have investigated will come to fruition, but the railway has already a sanctioned programme that will keep its engineers busy for many years to come."

With Colonel Walton the Governor united in congratulating the construction staff, and notably Messrs. A. Dale-Green, Cruickshank, Nizamuddin, Ross and Skinner on the satisfactory conclusion of their work on this line.

THE STANDARD "NINE."

UNDOUBTEDLY one of the most outstanding light cars for 1928 is the 9 h.-p. Standard, which is made in a variety of models at British prices varying from £190 to £215. This car is in no way a modification of earlier Standard light cars, but has been re-designed from the word "go" and represents everything that is most up-to-date in British motor engineering.

The engine is a side-valve four-cylinder with a bore and stroke of 60 by 102 m.m., and cubic capacity of 1,155 c.c., the British rating being 8·9 h.-p. The cylinders are cast *en bloc* with a detachable cylinder head and aluminium pistons are used, together with duralumin connecting rods. Magneto ignition, thermo-syphon cooling, with a large radiator and fan, and a 12-volt Lucas starting and lighting set are items of the specification. The clutch is of the disc type, asbestos lined, and the gearbox, which is of the central change pattern, gives ratios of 5 to 1 on top, 9·3 to 1 on second and 20 to 1 on bottom.

Metallic universal joints are used and the brakes, of course, are of the internal expanding type on all four wheels. The rear axle is of the worm type, and the front axle has been specially designed for front wheel brakes. Suspension is by semi-elliptic springs and the wheels are shod with 27 by 4·40 inches Dunlop balloon tyres. The wheelbase is 7 feet 8 inches and the track 3 feet 9 inches. The equipment for all models includes a driving mirror, speedometer, clock, dash lamp, petrol gauge, automatic screen wiper, centrally grouped instrument board, electric horn, licence holder, number plates and full kit of tools and spares.

The cheapest of the 9 h.-p. range are the Coleshill 2-seater and the Selby 4-seater touring car, each of these being listed at £190. They may be obtained in a choice of three colours, red, fawn and blue and they are upholstered in best leather cloth. Celluloid side curtains of the peg-in pattern are used, and the screen is of the sloping type. The Selby touring car has four doors, the Coleshill, of course, having only two, and the driving seats of both are adjustable.

Two types of saloons are made, the Falmouth at £215 and the Fulham at £198 10*s*. Although the wheelbase of the chassis is comparatively short the design of the body is such that there is ample leg room in all four seats, whilst the width of the doors allows for ease of entrance and exit. Both the saloons are fabric covered, the upper part of the Falmouth being in black and the lower in a choice of three colours, red, brown and blue. The front seat is adjustable and the upholstery is in cloth. The Falmouth may also be obtained with a Stanlite opening hood at the same price.

The Fulham is a model which was only introduced in February of 1928. It is similar in most respects to the Falmouth, but seeing that it is £16 10*s*. less in price it is devoid of some of the minor luxuries of the Falmouth car. It is, for instance, upholstered in repp and the fabric is of one colour instead of two. Sliding instead of wind-up windows are used and no luggage grid is fitted. Otherwise the car is almost identical with the Falmouth and certainly represents remarkable value for money.

The performance of the new Standard Nine can only be described as exceptional. The maximum speed of the saloon is some 48 to 50 m. p. h. when run in, but it is a feature of the car that it reaches this speed in a very short space of time, the acceleration being excellent. There is no noticeable period of vibration and 45 m. p. h. is a comfortable touring speed. It is thus possible to obtain as high average speeds with the little Standard as with many cars capable of over 60 miles per hour. The brakes are very sweet and efficient, steering is light and the car holds the road well at all speeds. It is interesting to note that petrol consumption works out at 38-40 m. p. g., whilst oil consumption is correspondingly low. At the British prices for oil and petrol the combined consumption thus works out at well under a half-penny a mile.

The 9 horse-power Standard has received unqualified praise from many of the most prominent of British motor correspondents, and it is certainly one of the finest productions of the famous factory. The efficiency of the cooling system is such that even when the car is driven all out for many miles the radiator gets little more than warm, and the car is thus particularly suitable for use in hot countries.

SAVING LABOUR IN LAWN-MAINTENANCE.

THE discoveries of steam, electricity and petrol have done more than anything else to reduce manual labour, and it is astonishing to what new uses these powers are being constantly put.

Apart from industrial installations, their domestic, agricultural and even horticultural applications are steadily growing in scope. Electricity, clean and instantly available, is best suited to the home, where the supply can be employed anywhere within a convenient radius. The adjective "cumbersome" is somehow associated with steam. The plant is heavy in proportion to its power, and generally unsuited for intermittent use on account of the time taken to reach a sufficient working pressure, failing which fuel must be consumed unceasingly between jobs.

Thus, briefly, may be suggested the reasons why the petrol engine is employed so widely—it is light, self-contained, compact and economical. It is long-lived and, in the present-dayform, dependable.

In one sphere of action, the petrol engine has proved its eminent suitability during the past decade. It is the application of this source of power to cutting the grass of lawns.

The motor mower is only just coming into its own. In pre-war days, there was hardly one in a county, but at the present time, their number is legion. The reason ?—largely on account of the high cost of labour, for the motor mower will cut a given piece of grass in a quarter of the time taken to do it by hand, or even less, while the expenditure of energy is infinitesimal. With a trailer seat that acts as an additional roller, even a partially disabled man can easily deal with several acres of turf in a single day.

One of the best known types on the market is the Dennis, which may be taken to illustrate the present-day trend of design, for this make has the unique

advantage of being manufactured by motor engineers of 33 years' experience, and consequently has many points of special interest.

To eliminate wear, all the moving parts of the engine are made of generous size, and amply and automatically lubricated oil is forced under pressure to the most important bearings from a reservoir, and provided that this is maintained, the internal parts of the engine may be left to look after themselves.

A common experience with 2-stroke engines when applied to lawn mowers, is that they overheat when in action, and frequently give trouble in starting. The Dennis mower is therefore provided with a 4-stroke power unit, which has the valve-stems and tappets enclosed by a detachable cover rendering them readily accessible for adjustment, but protecting them from dirt. A fan, driven by the engine maintains a constant flow of air round the cooled cylinder head, thus preventing any chance of over-heating.

Many other points might be detailed, showing how motor vehicle practice has benefited motor lawn mowers, but it will be sufficient to describe one further instance. The question of turning under power in a short radius, without damaging the turf, has unfavourably biassed many would-be purchasers, whose grounds include several small flower beds set in the lawns. This difficulty has been overcome by the incorporation in the Dennis machines of a differential gear identical in principle with the mechanism which enables a car or lorry to perform a similar operation. In the case of the mower, the driving rollers are constructed in three sections, interconnected by differential gear.

The solid merit of these machines is evidenced by the thousands in use in all parts of the world, and by the significant names that appear on the list of those who have purchased motor mowers of this make. In this connection, it must be mentioned that Messrs. Dennis Bros., whose factory is at Guildford, England, have lately received a Royal Warrant, appointing them manufacturers of motor lawn mowers —as well as of motor lorries—to His Majesty, King George V.

The Gazettes.

Burma, May 10, 1928.

Buildings and Roads Branch.

Mr. S. C. Roy Chowdhury, Assistant Engineer, on probation, Burma Engineering Service, is confirmed in his appointment.

Mr. J. A. Francis, Assistant Engineer, on probation, Burma Engineering Service, is confirmed in his appointment.

Mr. Hazara Singh, Assistant Engineer, on probation, Burma Engineering Service, is confirmed in his appointment.

Mr. A. R. B. Armstrong, I. S. E., officiating Superintending Engineer, made over, and Mr. J. N. List, M. C., I. S. E., Executive Engineer, received, charge of the Pegu Circle of Superintendence on 14th April 1928.

Mr. C. E. Scovell, I. S. E., Superintending Engineer, made over, and Mr. A. R. B. Armstrong, I. S. E., officiating Superintending Engineer, received, charge of the Mandalay Circle of Superintendence on 16th April 1928.

On completion of their practical training the following Apprentice Engineers are appointed as Assistant Engineers in the Burma Engineering Service, Class II, Buildings and Roads Branch, on probation for one year and nine months, with effect from 1st April 1928 :—(1) Bruce Taw, (2) Maung On Nyun, (3) Maung Ba Shin, (4) Hashim Bhoy, and (5) R. E. B. Rivers.

Leave on average pay for four months combined with leave on half average pay for eight months, for a total period of one year, is granted to Mr. C. Innes, O. B. E., I. S. E., Deputy Chief Engineer, Public Works Department, Buildings and Roads Branch, with effect from 28th June 1928, or such subsequent date as he may avail himself of it.

Leave on average pay for eight months is granted to Mr. A. G. Longley, Assistant River Conservator, Chindwin Division, with effect from 2nd August 1927. The leave is being spent outside India and Ceylon.

Leave on average pay for eight months is granted to Mr. J. F. H. Nicolson, M. C., I. S. E., Executive Engineer, Toungoo Division, with effect from 15th May 1928, or such subsequent date as he may avail himself of it.

Mr. H. V. Chapman, B. Sc., I. S. E., Assistant Executive Engineer, Toungoo Division, is, as a temporary measure, appointed to the charge of the current duties of Executive Engineer, Toungoo Division, in addition to his own, *vice* Mr. J. F. H. Nicolson, M. C., I. S. E., Executive Engineer, proceeding on leave.

Irrigation Branch.

The Governor in Council is pleased to direct that Captain W. L. Roseveare, M. C., R. E., I. S. E., Assistant Executive Engineer and officiating Executive Engineer, shall be promoted to Executive Engineer, substantive rank, with effect from 16th November 1927.

Leave on half average pay for one month is granted to Mr. G. Lynn, I. S. E., Assistant Executive Engineer, in continuation of the leave granted to him previously.

The following Apprentice Engineers are appointed to the Burma Engineering Service, Irrigation Branch, as Assistant Engineers on probation for a period of one year and nine months, with effect from 1st April 1928 :—(1) Mr. James Henry Halpin, (2) Maung Bi, (3) Mr. Robert Maung Tin.

Mr. J. P. Candy, M. Sc., Temporary Engineer, is appointed to the charge of the Dredger Division, with effect from 7th March 1928, *vice* Mr. P. Lawson, B. Sc., I. S. E., Executive Engineer, on leave.

Mr. E. W. D. Jackson, M. C., B. A., B. A. I., I. S. E., Executive Engineer, Shwebo Canal Remodelling Division, is transferred from the Northern Irrigation Circle to the Delta Circle and placed on duty in the Embankment Division, with headquarters at Henzada. Mr. Jackson's duty in the Embankment Division is equivalent to the charge of a Division.

On return from leave, Mr. G. Lynn, I. S. E., Assistant Executive Engineer, is posted to the charge of the Shwebo Canal Remodelling Division, Northern Irrigation Circle.

Mr. R. Berrill, I. S. E., Executive Engineer, Shwebo Canal Division, is, as a temporary measure, appointed to the charge of the Shwebo Canal Remodelling Division in addition to his own duties.

Punjab, May 18, 1928.

Hydro-Electric Branch.

On transfer from the Resident Engineer's office, Jogindarnagar, which he left on 10th April 1928, Mr. F. H. F. Manickshaw, Apprentice Engineer, joined the "T/h" Subdivision of the "T" Division at Brot as an attached officer on 10th April 1928.

Mr. J. A. Barber, officiating Assistant Secretary to Government, Punjab, Public Works Department, Buildings and Roads Branch, took over charge of the duties of Additional Assistant Secretary to Government, Punjab, Public Works Department, Hydro-Electric Branch, in addition to his own duties, on 8th May 1928, from Mr. A. S. Corrigan, who proceeded on leave.

Irrigation Branch.

Mr. J. D. Jackson, Executive Engineer, on transfer from the Delhi Division, Western Jumna Canal, which he left on 28th April 1928, joined the Bikaner Circle, Sutlej Valley Project, on the 30th idem, and took over charge of that Circle on 3rd May 1928, from Mr. T. B. Tate, Superintending Engineer, who proceeded on leave. Mr. Jackson has been appointed to officiate as Superintending Engineer, with effect from 4th May 1928.

Mr. A. Youngson, Assistant Engineer, on transfer from the Jhang Division, Lower Chenab West Circle, which he left on 17th April 1928, took over charge of the Hafizabad Division, Lower Chenab West Circle, on the 24th idem, from Mr. W. P. Thompson, Executive Engineer.

Mr. A. S. H. Perry, Executive Engineer, on transfer from the Majitha Division, Upper Bari Doab Canal, which he left on 14th April 1928, joined the 2nd Bahawalpur Circle, Sutlej Valley Project, on the 20th idem and took over charge of that Circle on the 23rd idem from Mr. J. D. H. Bedford, Superintending Engineer, who proceeded on leave. Mr. Perry is appointed to officiate as Superintending Engineer, with effect from 24th April 1928.

Lala Shauqi Chand, Assistant Engineer, on transfer from the Karnal Division, Western Jumna Canal, which he left on 18th April 1928, joined the Upper Dipalpur Division, 1st British Circle, Sutlej Valley Project, on the 26th idem.

May 25, 1928.

Buildings and Roads Branch.

On transfer from the Hissar Subdivision of the Ferozepore Provincial Division, which he left on 23rd April 1928, Lala Brij Mohan Lal, Assistant Executive Engineer, joined and took over charge of the Kangra Provincial Division on 30th April 1928, from Mr. W. C. Oram, Executive Engineer, proceeded on leave.

Notice.

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INDIAN ENGINEERING.

SATURDAY, JUNE 9, 1928.

WILLCOCKS ON BENGAL.

I.

THE lecture on "The Restoration of the Ancient Irrigation of Bengal," delivered in the British India Association Hall, Calcutta, by Sir William Willcocks last March, would appear to have caused some little consternation in certain quarters. But that was in no way surprising, if there was anything to be expected from Sir William it was the unexpected. He is like the curé in France who, when people remonstrated with him for the peculiarity of his views, said that he had not got up at dawn for thirty years in order to think with the crowd. He never looks on what he is called upon to advise through the spectacles of convention, he sees with his own eyes; and, seeing, he is fearless in the expression of his opinions whether they are popular or unpopular. He was never a man to give himself to shams in which he does not believe, his own faith is the principle of his action, and when he spoke, as he did at Calcutta, it was with all the audacity of an Old Testament prophet rebuking the Kings of Israel. Whether he was right or wrong, his sincerity is beyond dispute.

Sir William Willcocks was invited to visit Bengal to advise on the question of malaria in the delta of the Ganges, where the disease is a scourge, and he is not without knowledge of the subject as he had studied the reasons of the immunity from malaria of the cultivated Nile Valley from Aswan to the Mediterranean. His paper, entitled "Why is Cultivated Egypt Immune from Malaria?," was reviewed in these columns last January. He is convinced that Egypt would be partially immune from malaria any way because it uses the rich red water of the Nile floods, and that it is absolutely immune everywhere because it also grows everywhere an abundance of leguminous fodder crops which are inflowed at the critical time in the lives of malaria mosquitoes. From the analogy of Egypt, which he claims is the richest agricultural country in the world for its size, cultivating only 5,500,000 acres and paying a revenue of £38,000,000 a year without difficulty, he would have Bengal to follow its example. The climate of Bengal is not that of Egypt, Egypt is rainless, Bengal has an abundant rainfall, but there is a very wide range of clovers and legumens, and Sir William Willcocks holds that it should be possible to select suitable leguminous plants for cultivation in Bengal. But then he does not confine himself to that course of action only, he couples it with the necessity of restoring the ancient agricultural wealth of Bengal by means of irrigating the country freely with the rich flood waters of the Ganges. In that aspect of the question, whatever may be the opinions of the

Irrigation Department of the province, Sir William is likely to have had the warm support of the Director of Public Health. Bengal is not what would be termed in India an irrigation province, its rainfall is far too favourable for cultivation to render any satisfactory financial results from irrigation works in the ordinary way, and the so-called irrigation engineers of the province have been mainly concerned with navigation and drainage. Navigation is a feature of deltaic tracts, where waterways may be valuable as communications, and drainage may be desirable to improve sanitary conditions. But the Director of Public Health said in a volume not very long ago that: "Irrigation must be the watchword of Bengal rather than Drainage," and he gave his reasons very fully. It is therefore almost certain that he must be very much in accord with Sir William Willcocks' recommendations.

Sir William's lecture was given the title, the *restoration* of the ancient irrigation of Bengal. The author did not propose a new and original scheme of works, he proposed to restore the conditions of a time when, according to Bernier, an eye-witness, Bengal possessed "an endless number of canals" from the Ganges and was a country rich in wealth. From the evidence, it would appear that there were great canals in those days, and that in course of time because they were not maintained they silted up and came to be called dying rivers. Into the pros and cons of this theory it is not proposed to enter, we do not know enough. We take the case as Sir William stated it; and so taking it, it is clear that we have to revise some of our notions. The wise men of old did wonders in Egypt, but then Egypt without the Nile would be a barren stretch of sand, and Bengal presented quite a different picture. It was a bold view of the position to have constructed many large channels to carry the flood waters of the Ganges, even though they contained much fertile silt in suspension, over a country where the rainfall was not deficient. If that were done, it only shows how immense is the value of inundations of muddy water over lands, not rainless as in Egypt but having the rainfall conditions of Central Bengal. It is not impossible for that theory to be true, in tracts, where the soil is not manured and does not receive the attentions of scientific agriculture, the value of deposits of fertile alluvium can hardly be over-estimated. The system causes the land to retain its productive powers, and as long as the inundations, heavy though they may be, can flow over the ground surface unobstructed, there is no injury to animal or vegetable life. The post-war canal engineers of Sind who sought to deride their critics by informing them that inundation canals were not the last word in irrigation are likely to find that perennial canals in the delta of the Indus are not the last word in irrigation either. We know from what Sir William Willcocks, an eminent irrigation engineer, and Sir John Russell, an expert in agricultural science, have said that a vast amount of harm can be done by pouring lashings of clear water over land by modern methods. It has caused injury to land and loss of soil fertility in Egypt, India and America, where there has been no such injury or loss by the old inundation processes. Turbidity of flood waters and free flow on and off have never caused the evils with which irrigation officers are confronted to-day, and on the evidence there is good reason to suppose that the ancients of Bengal knew very well what they were about.

Sir William Willcocks maintains that Central Bengal once enjoyed the rich irrigation of the Ganges floods mingled with the waters of the monsoon rainfalls, and reaped fatiguing crop after fatiguing crop with no leguminous rotative crops. At the present time, deprived of the rich red water, it has to content itself with rain water for its worn-out fields, and rain cannot restore the lost fertility. Forced to grow some kind of legumens, it grows the poorest and reaps scanty harvests. Cattle are weak and diminutive, they have not the nutritive leguminous fodder crops of Egypt. Over large areas one single crop in two years is the rule. Kans grass is spreading in some districts. The fall of sub-soil water is telling on the fertility of mango and other fruit trees, which are shallow rooted and were once accustomed to other conditions. The absence of pools has deprived most of the peasantry of the fish they used to have in abundance. Drinking water is often scarce. The people are badly nourished and scourged with malaria, which nothing but the turbid waters of Ganges floods and leguminous fodders can combat and these they never see. It is not a pretty picture; but Sir William says that he is an optimist of optimists and no pessimist, and in that spirit he sketches his scheme for making Central Bengal live again. Much as he said in his lecture, it could obviously only be a sketch. It is a very big project, and in the time at his disposal he was unable to do more than to give its main features in broad sweeping lines. The very thought of it may have startled the Bengal engineers, it looks easier than it is in the forceful way that Sir William tells the story, and apart from the engineering side of it, there is the finance to which reference will be made in another chapter.

(To be continued.)

ELECTRICITY.

It only takes a glance at a publication such as the recent Electrical Number of the "Times Trade and Engineering Supplement" to realise how rapidly the field of application of electricity is widening. It is an invaluable form of power, and though—as the "Times" says—less than half a century has passed since the use of electricity became a commercial proposition, so wide is its present influence that there is scarcely any human activity into which it does not enter. In the pioneer work of the development of the science Great Britain has played a foremost part, the whole world owes a debt of gratitude to men like Gilbert, Faraday, Maxwell, Kelvin, Parsons and others, and

within the Empire we have reason not to forget them. On the manifold benefits of electricity, Mr. Victor W. Dale has an admirable article in the "Supplement." The industry forms one of the largest and most important of the branches of engineering, in Great Britain there are nearly two million workers employed in the electrical trade, and as time goes on there is hardly any question that electricity will confer more and more happiness and prosperity on all peoples. It reduces toil and it increases production, it makes the world smaller by the rapid communication of knowledge, it renders homes and workshops more hygienic and pleasant, it contributes to the healing of the sick, it improves the lighting of homes, places of business and public highways, and by and by it will benefit agriculture more than can at present be foreseen.

Most of us, engineers, are aware that electricity is now the life-blood of industrial processes and that modern industry could not function without it. The electric motor has shown its superiority for almost every kind of drive. Electric traction on railways and tramways is valuable, and for underground railways in tunnels and tubes it is a necessity. Telegraphy and telephony, it is hardly necessary to mention. The value of electro-metallurgy is immense, and some day, with the vast amount of water power available in India, there may be great developments in this country. In medicine, electricity has not perhaps a long history, but it is now used extensively both for purposes of diagnosis and treatment. Illumination enables inspection of sites of disease, diathermy is used for destruction of diseased tissue by cauterisation, and the future has much in store for the benefit of patients. For general domestic business electricity has also a short history. It is not only a question of light, there is heat, and in the past few years there has been remarkable progress. The electric fire has a high thermal efficiency, and the latest imitation coal fires tend to satisfy æsthetic cravings. Electric cooking and electrical refrigerators are increasingly coming into use, and there are many other ways of utilising the power. It is said that in the United States, where 92 per cent. of the houses are servantless, there are more than 10 millions of electric irons, 5 millions of electric suction cleaners and 3½ millions of electric washing machines in use. So the servant difficulty is becoming less acute.

For farming, in countries where labour is expensive, the application of electricity may solve some serious problems. In Great Britain there were some 200 electrified farms in 1924, and now there are about 750. In the United States there are 227,442 farms connected to central electricity supply stations; and as the need for production increases to meet the food demand owing to increase of population, and the cost of producing electricity cheapens, more advantage will be taken of this form of power. The farmer has always been confronted with difficulties, he cannot speed up manufacture in the same way as in other industries, he has nature's laws which restrict him, and there are all the uncertainties of unfavourable weather, plant disease and other adverse conditions. Nevertheless electricity is helping him in the direction of economy. In India, electrified farms may seem to be so far distant as to be negligible at present, but the times are moving so fast that they may come sooner than we expect. India is an immense agricultural country, her greatest industry is agriculture, and she has vast resources in water power. Except in a few places where a demand for hydro-electric energy already existed the difficulty in India has been the likelihood of finding a full and quick use for the power generated. Water in a sense costs nothing, but schemes to utilise the power cost a great deal, and in the absence of sufficient demand they may prove commercially to be very unprofitable. Once, however, the pressure of circumstances leads to the use of electricity farming, as it is doing in the West, the case may wear a different aspect, and possibly the first call may be for power for pumping. In tracts where there is no supply of water for irrigation by gravity, and electric power is sufficiently cheap, there may be a demand for power to lift, and elsewhere, where there is water-loggng of the soil by reason of canals or otherwise there may also be a demand. It is all a matter of time, and in India, as in other countries, the value of electricity will be fully recognised. The "Supplement" which deals with this form of power in all its bearings is intensely interesting.

SURVEY OF NEPAL.

A NOTABLE event of the survey year, 1st October 1926 to 30th September 1927, is that the first modern Survey of Nepal, commenced in 1924, was completed in March 1927. The general report of the Survey of India for the year concerned says that in 1924 His Highness the Maharajah asked for the co-operation of Indian surveyors for the purpose of preparing complete modern maps of the whole of Nepal. This act has resulted in one of the greatest single contributions to Himalayan geography which has ever been made, as for the first time has been obtained accurate knowledge of the drainage and structure of 55,000 square miles of country (an area approximately that of England and Wales), extending over some of the greatest mountains of the world, including the highest known peak, Mount Everest, over 29,000 feet above sea level. The field work was carried out on the scale 4 miles to one inch by a staff of surveyors under Mr. Jugal Behari Lal and Mr. Lalbir Singh, and two Nepalese officers did valuable work in organising transport and supplies in the very difficult country. The total area surveyed covers the whole of Nepal up to the borders of previous Indian surveys, except three small portions. In two of these portions, 60 and 150 square miles, work was stopped by continuous snow-storms, and the third could only have been surveyed by crossing the border into Tibet. The country surveyed has features and climate

of great diversity. On the south there is the low-lying Tarai tract, covered with forest and very malarious. In the centre the country consists of steep hills, 5,000 to 10,000 feet high, largely forest covered and cut up by deep valleys. On the north is the main axis of the Himalaya, a region of high cliffs and perpetual snow, where survey is made additionally difficult by mist and cloud. Everyone will agree that in such conditions of climate and topography the successful completion of the survey in the short time of three years is a great achievement, reflecting much credit on the officers and surveyors concerned. It is also most satisfactory that, considering that the triangulation had to be carried out concurrently with the topography in the first two seasons, the resulting surveys should have shown such a high degree of accuracy. It is said that none of the stations in the triangulation is likely to be as much as 100 feet wrong in position or 20 feet in height. The junction of two series of triangulations revealed closing errors of 0''·51 in latitude, 0''·87 in longitude, and 15 feet in height. Apart from a few cases of doubtful identification, fixings of distant peaks, whose positions were previously known, agree within 250 feet in position and 50 feet in height, and the agreement is generally much closer. The small inaccuracies will be practically inappreciable when the maps on the 8 miles to an inch scale are prepared. The work of the Survey of India is, however, so habitually good that it is becoming almost tiresome to congratulate the officers and men of the service on any particular piece of work. It is interesting to note that, as regarding nomenclature of peaks, the Nepalese only give specific names to a few snow-covered peaks of specially remarkable aspect. But each group of snowy peaks is called a *Himal* or "Abode of Snow," and has a name.

Mount Everest dominates the Maha Langur Himal, Kinchinjunga the Singalila Himal, and so on. Mount Everest itself has no Nepalese name.

RAILWAYS IN BARODA.

IN the new book "The Ruler of Baroda," in which the author, Mr. Philip W. Sergeant, gives an account of the life and work of H. H. the Maharaja Gaekwar, there is a chapter on the railways of the State. Railway enterprise in Baroda territory dates back to 1856, when Maharaja Ganpatrao ceded a strip of land for the construction of the Bombay, Baroda and Central India Railway. This was, however, a British enterprise, and it is Maharaja Ganpatrao's brother, Khanderao, who has the credit of starting the first line of any kind for Baroda itself, when he resolved to build a light railway from Miyagam, on the B. B. and C. I. Railway, to the trading centre Dabhoi, 20 miles to the east. Old rails were used, and the narrow-gauge (2 feet 6 inches) line was opened in 1869 at a cost of Rs. 50,000. It was not a financial success, and its working was subsequently made over to the B. B. and C. I. Railway. It was re-opened for regular traffic in 1873, and was the first native-owned railway in any Indian State. Thus, at the beginning of his minority, the present Maharaja, H. H. Sayajirao Gaekwar III, found his territory provided with 20 miles of light railway, in addition to British-owned main-line traversing the State from south to north. The next two lines, one connecting Dabhoi with Bahadapur and the other with Chandad, were opened in 1879 and in 1880 Dabhoi was connected with Baroda City. A small two-mile extension was added in 1881, and when His Highness took over the administration there were 59 miles of State-owned light railways in working order. The great personal interest taken by His Highness in railways is shown by the fact that Baroda has now 642 miles of line, 21 miles of broad-gauge (Anand-Petland-Tarapur), 304 of metre-gauge (in Kadi, Amreli and Okhamandal) and 316 of narrow-gauge (in Baroda *prant* and Naosari). The broad and metre gauges are worked by the B. B. and C. I. Railway, and up to 1921 the B. B. and C. I. Railway worked the narrow-gauge lines also, but in that year these lines were taken over by the Baroda Government. During the last four years for which figures are available, the numbers of passengers carried appear as 2,574,630 in 1922, 3,271,432 in 1923, 4,000,572 in 1924, and 4,736,723 in 1925. The figures show that the conveniences of travelling by rail are now much appreciated in the State. In the Baroda and Kadi *prants* the networks of railway are said to be admirable. In Kadi, the lines, metre-gauge throughout, radiating from Mehsana, connect every *taluka* with the others. The railways have made Mehsana, which is in the centre of a good cotton and oilseed district. It used to be a small town, but has now fine Public Offices built at a cost of Rs. 4,43,532, large Police Barracks completed at a cost of over half a million of rupees, a Jail, a well-equipped Hospital, a Veterinary Hospital, a High School and Hostel, a Public Library, a Club, and a branch of the Bank of Baroda. In the central *prant* of Baroda, the capital is now linked up by rail with every outlying place of importance. The comfort of passengers is moreover studied, the rolling-stock compares favourably with that of other Indian railways, and the carriages are now being fitted with electric light and other conveniences. At Goya Gate, two miles to the south of Baroda old city, are up-to-date workshops, where everything connected with railways is turned out, except wheels, axles and springs. There is a power station, which supplies the needs of the railway shops and also of all private consumers in Baroda City. The capital sunk in the Goya Gate works is over Rs. 30,00,000, and the annual receipts from the sale of electric energy are Rs. 3,00,000. It is said that the electrification of the suburban lines has been under consideration, but pending their further development this action is not yet held to be justified. As a railway builder, the Maharaja, not so much for the sake of return on capital expenditure as in the interests of the general development of the State, has shown much enterprise.

Notes and Comments.

Henry Pells.—This firm of 32-40, Osnaburgh Street, London, N. W. 1, have published their Price Stock List, 1928, of presses, punches, shears, for which they are so well noted. We have often had occasion to refer to this firm in previous issues.

Acknowledgment.—Copy of a paper by Dr. J. A. L. Waddell entitled "Mathematics from a Consulting Engineer's Viewpoint," which was delivered two or three years ago at an International Mathematical Congress at Toronto. This is the first time it has been put in print.

New Nerbudda Bridge.—On 1st June the first train passed over the bridge. The opening of this the shortest route to Bombay, *viâ* Jubbulpure, means that the Imperial Mail from Bombay reaches Howrah 3 hours 35 minutes earlier. Since the bridge was washed away in 1926, trains have had to traverse an additional 97 miles *viâ* Katni-Bina-Itarsi.

Railway Finance Committee.—One of the eight new schemes recently discussed by this Committee at Bombay was the Chittagong-Nazirhat project which proposes to extend 23 miles of railway on the Assam-Bengal section. The Railway Board has allotted a sum of Rs. 5 lakhs for the scheme in the current year's budget. Construction work has already started.

King Amanullah "Buys British."—During his recent stay in England, King Amanullah of Afghanistan visited a number of engineering works in various parts of the country, including the famous Rolls-Royce Works at Derby. Subsequently he placed orders for four Rolls-Royce cars, including enclosed drive bodies and an open tourer by Hooper and Co., Ltd. British workmanship will thus be worthily represented in the Afghan capital.

Hyderabad Drainage.—The progress report of these works states that during the last six months work was hindered by plague. The drainage scheme is estimated to cost Rs. 1 crore. Since the works were started 2½ years ago the expenditure has been over Rs. 17 lakhs against a provision of Rs. 30 lakhs allotted for the first 3 years. The recommendations regarding the disposal of sewage are being adopted and it is proposed to acquire an irrigable area of about 1,000 acres for the present below the existing Uppal Channel for the purpose of a sewage farm.

A Romantic Flight.—Flight-Lieutenant R. R. Bentley has a reputation as an airman, and only last year won the Britannia Trophy for the best air flight of the year by flying alone and in a very small 'plane from London to Cape Town in a month. Ambition to earn this trophy would not, however, appear to have been his incentive, for he undertook the 8,000 miles journey by air to be married, and married he was. But that did not mean any cessation from air exploits as the young couple decided to fly another 8,000 miles back to London, where they arrived safely on the 12th May last. The flight was accomplished in the same tiny two-seater, and Mrs. Bentley learnt, it is said, how to pilot a 'plane in the course of the journey, so that she was able to relieve her husband of his responsibilities on various occasions. It was an adventurous and apparently an enjoyable trip, for Lieutenant and Mrs. Bentley have announced their intention to fly back to South Africa in the autumn.

Port of Bristol.—The extension of the eastern arm of the Royal Edward Dock, Avonmouth, which was opened on 23rd May by H. R. H. The Prince of Wales, is an outstanding example of the value of reinforced concrete for industrial construction. The scheme which was commenced in 1923 comprises concrete wharves on the east and west sides of the extension, two treble-floor transit sheds, a transit silo granary and grain galleries—all in reinforced concrete. The new arm of the dock is about 1,700 feet long and 400 feet wide with provision for three deep water berths on each side.

Record Non-Stop Engine Run.—There are many engines in various parts of the world which run for very long periods at a time, and of these no doubt careful records are often kept. It would be interesting to know, however, whether any better performance has been recorded than that of an engine installed some years ago at large metal works in Australia. This was a 250 i. h.-p. compound condensing engine, built by John Fowler and Co., of Leeds, and it completed six years' continuous run of 24 hours a day without a stop of any kind. During this period it is estimated that the flywheel travelled the colossal distance of 2,198,760 miles.

Fire and Salvage Boat for Rangoon.—Messrs. Merryweather and Sons, Limited, Greenwich, are building a powerful twin-screw fire and salvage boat to the order of the Municipality of Rangoon. She will be 75 feet in length, and will be fitted with two internal combustion engines, each capable of developing 200 b. h.-p., which have been designed for a speed of about 10½ knots. Two fire and salvage pumps of the latest Merryweather turbine type will be fitted, each of which will have a capacity of 1,250 gallons per minute for fire duty and 2,000 gallons per minute for salvage duty. The vessel will be equipped with a double-swivelling monitor to throw a jet of 3½ inches diameter, and a portable monitor for use on land, as well as a marine searchlight of 20 inches diameter.

B. B. and C. I. Railway.—On the 25th April last the foundation work was commenced on the new passenger terminus of this railway for long distance trains. This station which will be known as "Bombay Central" is situated just north of Bellasis Bridge, the approach to the main entrance being from Lamington Road. The new station will consist of an imposing three-storied structure. The cost of the scheme will amount to Rs. 156 lakhs. Every convenience for passengers is being considered. A new suburban line station is to be constructed at Bellasis Road alongside the Central Station and there will be a direct connection between the two stations by a foot overbridge. It is anticipated that Bombay Central will be opened for traffic in 1930 and on its opening the terminus at Colaba and the line between Colaba and Church Gate Stations will be dismantled. The Electric Suburban Train service which at present runs to Colaba will then terminate at Church Gate Station.

Bengal Tanning Institute.—The Bengal Tanning Institute provides a two years' course of instruction in modern tanning. A demonstration tannery equipped with necessary machinery and a chemical laboratory are attached to the Institute. The training is imparted through practical work and lectures; manufacture of different varieties of commercial leather

from local hides and skins is practised at the demonstration tannery; and the chemical analyses required in modern tanning are taught at the laboratory. Courses of lectures are delivered on principles and methods of tanning and analytical chemistry of leather manufacture. Thirty-nine students have passed out of the Institute. Eight took only one year's training and the rest completed the full course. Among the past students eight have started small tanneries, five are doing business on their own in leather goods manufacture, and sixteen are tanning chemists and tannery assistants. Two are working as assistants in laboratories and one in a distillery. More than 82 per cent. of the trained students of the Institute have been suitably employed.

An Unusual Marine Motor Installation.—An 18 feet motor boat with an ingenious power installation has recently been designed for a large drainage scheme in the North of Ireland. It is to operate on the undredged portions of a shallow and weed-infested river and the draft is restricted to 6 inches. The problem has been to meet these exacting conditions, and yet provide an ample margin of power to drive the boat through the weeds. This has been attained by adopting a system of hydraulic propulsion in conjunction with a light, compact yet powerful engine. The engine selected as the one that best meets these conditions is known as the Ailsa Craig Kid; it is produced by the well known marine engineers to His Majesty the King, the Ailsa Craig Motor Co., Ltd., of Chiswick, London. It is of monobloc construction with overhead valves and is capable of a power output 25 per cent. in excess of other engines of similar size and weight. In combination with the propelling pumps, which avoid any necessity for an outside propeller, the Ailsa Craig Kid engine will drive the boat anywhere, no matter how shallow or weed infested the waters.

British Marine Engines in Africa.—One particular British made marine engine that is giving excellent account of itself overseas, is the "Empire" 10 h.-p. four-cylinder motor which J. W. Brooke and Company, Limited, are producing in large numbers at their Lowestoft Works. A utility type engine, light, compact, economical and suitable for a large range of craft, the "Empire" motor is now a popular power unit in all countries where motor craft are used, and in this connection, Africa is no exception. One of the first engines of this type was imported into Durban five years ago, and it is reported this motor has been in daily service ever since, running in all weathers. The owner of the boat installed with this engine reports too that on no occasion has it ever let him down, and when recently the engine was dissembled for inspection, the wear on parts was infinitesimal. Other "Empire" engines are all doing excellent service on Durban Bay in pleasure craft, and another shipped to the same town was installed there in a 22 feet craft which after satisfactory trials on Durban Bay was despatched to Vereeniging for service on the dam, built on the Vaal River, where it is rendering good service.

Cauvery-Mettur Project.—The Administration Report of the Public Works Department, Madras Presidency, states that the cost of the scheme has been underestimated. The outlay on the project during the year was Rs. 52·84 lakhs, and to the end of the year Rs. 61·53 lakhs against the estimate of Rs. 6·12 crores. The dam will have an additional height in consequence of the storage permitted by the Mysore agreement. The foundations will go to an additional depth, as sound rock in some places is lower than anticipated. The 1924 floods require additional surplus facilities. The extra cost under this head may amount to Rs. 40 lakhs. In the original estimate communications were underestimated, drainage was entirely omitted, provision for housing and coolie camp was inadequate, and the sanitation and medical resources were insufficient. Under all these heads there may be an excess of Rs. 50 lakhs. The balance of the excess will be in establishment owing to the additional staff required for an accelerated programme and to the higher class of establishment required for a dam on which much machinery will be employed. It is, however, anticipated that the revenue will be increased by the additional capacity of the reservoir.

Exhaust Turbine Drive.—The news that the Anchor liner "Britannia" is being fitted with the Bauer-Wach system of exhaust turbine drive is of considerable interest to those concerned with cutting down expense in the operation of steamships. The "Britannia" is fitted with a large quadruple engine, developing some 4,800 i. h.-p., oil-fired and supplied with superheated steam. She is already one of the most economical ships on the line. The Bauer-Wach system will make use of exhaust steam at present wasted to give still further power, or, alternatively, reduced fuel consumption. The turbine, which is a small high-speed unit, drives the main propeller shaft through toothed gearing, in which is embodied an hydraulic clutch. This turbine and clutch are only in operation when going ahead for a long uninterrupted run; they are cut out during astern running and manœuvring, when steam from the main reciprocating engine passes direct to the condenser. It is anticipated that the new equipment will reduce the consumption of this already economical vessel by 15 per cent. It may be recalled that the Bauer-Wach system of exhaust turbine drive has been applied to a large number of Continental-owned vessels with conspicuous success. One of its great advantages is that it can be fitted to existing vessels at relatively small expense.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 23rd May 1928:—Messrs. Martin and Co., Calcutta—1 lot Spares, for 300 Dragline excavators, Rs. 1,055 c. i. f. Karachi; Messrs. Robert Hudson (India), Ltd., Calcutta—6 Bogie Trucks, gauge 30-inch buffer, height 12 inches, Rs. 10,200 f. o. r. Calcutta by 15th July 1928; Messrs. Jessop and Co., Ltd., Calcutta—100 Pipes, cast iron spun, 12 feet length, 4 inches diameter, *ex* Bombay stock, Rs. 1,537 free delivery at Secunderabad *ex* stocks; 100 Pipes, cast iron spun, 12 feet length, 4 inches diameter, *ex* Madras stock, Rs. 1,537 free delivery at Secunderabad *ex* stocks; 262 Pipes, cast iron spun, 12 feet length, 4 inches diameter, *ex* Calcutta stock, Rs, 5,035 free delivery at Secunderabad *ex* stocks; 22 Pipes, cast iron spun, 12 feet length, 6 inches diameter, *ex* Bombay stock, Rs. 567 free delivery at Secunderabad *ex* stocks; 230 Pipes, cast iron spun, 12 feet length, 6 inches diameter, *ex* Madras stock, Rs. 5,922 free delivery at Secunderabad *ex* stocks; 33 Pipes, cast iron spun, 12 feet length, 8 inches diameter, *ex* Bombay stock, Rs. 1,145 free delivery at Secunderabad

ex stocks; 99 Pipes, cast iron spun, 12 feet length, 8 inches diameter, *ex* Madras stock, Rs. 3,434 free delivery at Secunderabad *ex* stocks; 27 Pipes cast iron spun, 12 feet length, 8 inches diameter, *ex* Calcutta stock, Rs. 1,181 free delivery at Secunderabad *ex* stocks.

The Triumph of Television.—In the early morning hours of 9th February one more dream of science was turned into actuality. Man's vision spanned the ocean, spanned thousands of miles of space, and Transatlantic television was proved to a reality. This result was achieved by the Baird Television Development Co., of London, which was recently formed to exploit the television patents of Mr. J. L. Baird. It was Mr. Baird himself who conducted the experiments on the British side of the Atlantic, the apparatus used being a short-wave transmitting set specially devised for sending out "vision sound" waves. The animate visions of three or four people were transmitted, and were picked up by a group of people at a private receiving station at New York, who were using a Baird Televisor for reconverting the sound into vision. Although these visions were not perfect they demonstrated clearly the wonderful possibilities of television. This success has been particularly gratifying to the General Electric Co., Ltd., of Magnet House, London, for it was on Osram valves that success was achieved. Not only did Osram transmitting valves play an important part in the development of the television system, but Osram L.S.5a valves were also used in the receiving sets both in England and in America, where they were preferred to all others. Mr. Baird reports that these valves operated perfectly during the whole of the experiment.

Giant Metal Monoplane.—The design and construction of the land aeroplane with the greatest span in the world is an achievement which stands to the credit of British designers and work-people. The machine in question is the giant all-metal monoplane, the "Inflexible," which has just been built for the Air Ministry by William Beardmore and Co., Ltd., and has flown very successful trials at Martlesham Heath. The engines are three Rolls-Royce Condors of 650 h.-p. each, one mounted in the nose and one on each side of the fuselage. The machine measures 150 feet from wing-tip to wing-tip, has a weight of approximately 15 tons, and can carry at least 20 passengers. It is difficult to indicate by these statements the appearance of this metal giant. Its landing wheels alone stand 7 feet 6 inches high, and the huge tyres add to the impression of Gargantuan size. Two standard Royal Air Force fighters could comfortably nestle under each wing. Even the tail fin and rudder rises practically unsupported more than twice the height of a man above the fuselage, which, with the tail wheel on the ground, is itself some 6 feet above the earth. The stout rectangular fuselage in the cabin section is about 12 feet deep, but perhaps the most vivid impression of this super-magnification of the normal aeroplane was the spectacle at the trials of a man walking along the wing, as casually as a passenger passing up a ship's gangway, to examine the controls, and then running down the broad back of the fuselage, to be dwarfed by the tall tail fin as he checked fittings there after flight.

History Repeats Itself.—The possibilities in connection with the use of chain as a power transmission medium were foreseen in 1879, when Mr. James Starley, inventor of the bicycle with the big and little wheel, was supplied with the first bush roller chain invented in that year by Mr. Hans Renold. Later, this type of chain was fitted consistently to motor cycle primary and rear drives as well as to the camshaft for automobiles. In 1895 Mr. Hans Renold made a further great advance in chain making by designing a smooth running chain with comparative lack of noise, known as the "Silent" chain. Meanwhile, a factory had been built by the manufacturer of these chains and the firm of Hans Renold, Ltd., had established a reputation for a quality product giving reliability, long life and efficient service. To-day the Renold chain continues to give absolute satisfaction on the road and on the track. Just recently a letter was received from the owner of an A. J. S. combination, 1923 model, on which he stated that he had covered 40,000 miles, and at the completion of this mileage the original chains were still on the machine, and in 'extremely good condition. Another owner of a Triumph Ricardo, which was purchased in 1923, reports that the Renold chains fitted to his machine have covered a mileage of 20,000 miles in all weathers, and that he has never at any time had cause for the slightest anxiety on their account. The condition of the primary chain, we are given to understand, is such that it might have been fitted yesterday, and the rear chain is still good for many more miles.

A £165,500 Contract for a British Firm.—Leyland Motors, Limited, of Leyland, Lancashire, have recently secured a notable triumph with their new two-axle double-decked 'bus by obtaining an order for 100 "Titans" from Glasgow Corporation. This Corporation has for some time past been experimenting with a number of different types of 'buses, amongst which were a number of "Titans" ordered at the end of last year, and it is as a direct result of these experiments that the order was placed. The cost of each vehicle is £1,655, making the total value of the contract £165,500. This order now makes possible a big forward move which the Tramways Department have had in view for some time. Hitherto the theory was that the 'buses should only be used as "feeds" for the trams. Now new routes will be opened and the 'buses will not only serve new housing schemes, but the routes will be arranged so as to pass through the City, and so add to the general transport facilities. It will be recalled that the "Titan" was first offered to the public at the Commercial Vehicle Show at Olympia, London, last year, where it created no little interest, both by reason of its being the only six-cylinder double-decked 'bus on two axles, and also because of its unconventional design. This allows for 51 seats, 24 on the lower deck and 27 on the top deck, so arranged that the gangway on the top deck is along the off-side instead of the centre as is customary. This patented construction in conjunction with the off-centring of the transmission permits of an easy stairway and an overall height of under 13 feet. The overall length is 24 feet 9 inches. It is perhaps worthy of note that, although the Company has in production a three-axle double-decker to seat 68 passengers, it has maintained that in all but very exceptional circumstances the addition of the third axle is unnecessary, an opinion which is very much strengthened by this order from Glasgow Corporation.

Current News.

MR. P. N. RAJAGOPAL is posted as examiner of Local Fund Accounts in the Punjab.

DR. W. A. K. CHRISTIE, Chemist, Geological Survey, is granted leave for five months.

MR. C. H. POWELL is appointed to officiate as Principal, Government Carpentry School, Allahabad.

MR. F. A. CLAY, Assistant Engineer, P. W. D., United Provinces, is attached to the Agra Division.

KHAN BAHADUR TAJUDIN MALAK is appointed to officiate as Deputy Accountant-General, Public Works, in the Punjab.

AN important new scheme concerning meteorological observation in India has been sanctioned by the Government of India.

THE Government of Bihar and Orissa have decided to transfer the Radium Institute from Ranchi to Patna. The institution in Patna will open on 16th July.

A NEW company has been formed in Pretoria for the manufacture of reinforced concrete pipes. Its title is the Viviani Ferro-Concrete Pipe Company.

AT a meeting of the Hooghly District Board it was decided to ask the Government for a loan of rupees two lakhs for sinking tube-wells in villages within the District.

SIR ROBERT A. HADFIELD, the distinguished British engineer, chemist, and metallurgist, has been elected a Foreign Associate of the National Academy of Scientists, Washington

A WATER-WORKS scheme for Asansol, costing Rs. 4½ lakhs, has been gazetted and, it is expected, will be sanctioned in two months time, when the work of construction will be begun.

MR. G. R. DAIN, Agent, Calcutta Tramways Company, will leave for England on 16th June. Mr. W. R. Pepper, Chief Engineer, will, it is understood, act as Agent during Mr. Dain's absence.

THE large floating dock for Singapore will leave England this month with a convoy of eight powerful tugs on its 8,500 miles journey, which is expected to take three months. The structure is understood to have been insured for £900,000 in the London market.

HIS MAJESTY'S Senior Trade Commissioner in South Africa reports that, according to the local technical press, the Transvaal Provincial Administration is proposing to allocate a sum of about £40,000 for the purchase of roadmaking machinery and appliances.

THE British Electrical Development Association announces that they are organising a propaganda campaign in favour of British electrical refrigerators. This will last from 8th to 25th June and will comprise window displays and local and direct mail advertising.

THE India Office has ordered from Hadfields, Limited, Sheffield, three plants—the largest of their kind ever built in England—each capable of crushing 120 to 150 tons of stone an hour for concrete for the Cauvery and Metur Dams in the Madras Presidency.

TESTS made on the brown coal mined at Waikato, New Zealand, show that it can be briquetted commercially; 1 ton of the coal will yield 12 cwt. of semi-coke, containing 7¾ per cent. volatile matter, 10·8 gallons of tar oil by condensation—which is equal to a yield of 4·6 per cent. on the coal—1·69 gallons of light oil; the calorific value of the semi-coke is 7,180 calories, or 12,924 B. Th. U.

ACCORDING to a cable message in "The Times" for 4th May, yet another change is to be made in the administration of the New Zealand Railways. They have always been State-owned and administered by railway commissioners through a general manager. In 1924 a Railway Board was appointed, whose chairman replaced the general manager. That position, the cable says, is to be revived and the Board abolished.

THE new field house for the University of Minnesota in Minneapolis, which has just been completed, is, according to the "Engineering News-Record," a structure 440 feet long and 236 feet wide. The main structural frame of fourteen three-hinged steel arch trusses, 100 feet high at the centre and spaced approximately 30 feet apart along the building, is enclosed in brickwork and covered with a steel plate roof insulated and waterproofed.

IN connection with the scheme to connect Korea and Japan by submarine telephone, the section from Fukuoka to Idzuhara, in Japan, was incorporated in the Budget of 1927, and the work will be carried out shortly. The section from Idzuhara to Fusan, in Korea, is included in the Budget for 1928. The cable will be purchased abroad, and immediately on its arrival the work will be put in hand, an item of 700,000 yen (about £70,000) being allotted for this purpose. It is expected that the line will be completed by October next.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

ROLLER BEARINGS FOR RAILWAY CARS.

SIR,—With reference to your short note taken from the "Railway Gazette" on the subject of roller bearings for freight cars, there is an important point which must be carefully considered by wagon superintendents who contemplate adopting roller bearings for their rolling stock. We are told that it was shown by the experiments that the ratio of the starting resistances of the two experimental cars was 8·8 to 1 in favour of the car with roller bearings. What does this imply? Assuming the starting resistance of a car with plain bearings to be, say, 21 lb. per ton, the starting resistance of a car with roller bearings would be, say, 2·24 lb. per ton. In other words, this car would be self-starting on all gradients steeper than 1 in 1,000, unless the brakes were kept on tight. This may be no great fault in the case of lines in a flat country, but would make the car far too nimble on most railway lines in the world.

DILAMBDA KAPPA.

VALUE IN BRITISH CARS.

SIR,—The year of 1928 has already been marked by one thing—the low prices of first-class British cars. Small and medium-sized cars are now within the reach of men and women with very modest means and the times may soon be coming when "every man his own car—and a British car at that" will be a British slogan.

The 14 h.-p. Standards, at the new prices just announced, are examples of the very best British value. These cars are now listed at the following home prices: Canley 2-seater £220, Sidmouth tourer £225, Stratford tourer £250, Sherbourne touring saloon £265, Corley coupé £280, Farnham fabric saloon £280, Pall Mall saloon £325.

The announcement of the new prices, coming as it did just before Easter, was followed by large sales. Each car is remarkable value, but perhaps the most outstanding are the Stratford tourer, the Sherbourne touring saloon and the Farnham fabric saloon.

The Stratford is by no means an ordinary touring car, for the side-curtains are in reality windows, of the pull-up type, but made of celluloid instead of glass. Thus they can never become cracked or scratched—the two main disadvantages applying to side-curtains of the ordinary pattern. Many motorists, indeed, consider that this system, which was introduced by the Standard Company two years ago and is fully patented by them, makes side-curtains preferable to glass windows, in that they are lighter, safer and cheaper; in addition, the car can be converted into a full tourer in a few seconds, should fine weather render this desirable.

Until recently the Farnham saloon cost £325, and at that figure it was considered very good value, with its excellent performance, luxurio usupholstery and handsome appearance. At its new price of £280 there is little on the market to touch it. The same remarks apply to the Sherbourne touring saloon, which at £265 is particularly attractive.

MOTORIST.

Literary Notices.

Preparation of Plans for Railways.—By Colonel Sir Gordon Hearn, Kt., C. I. E., D. S. O., Assoc. Inst. C. E., M. Inst. E. (India), late Chief Engineer, Khyber Railway, and Agent, Eastern Bengal Railway. Calcutta and Simla: Thacker, Spink and Co. London: W. Thacker and Co., 2, Creed Lane, E. C. 4. 1927. Price, Rs. 10.

This is a very valuable work on the Preparation of Plans for Railways and contains full information for the guidance of draughtsmen and engineers who have to deal with the same. It is a technical work which could only have been written by an expert engineer who thoroughly understood the ins and outs of the subject.

Tacheographs for Reduction of A. Distance and B. Height.—Two parts. By Colonel Sir Gordon Hearn, Kt., C. I. E., D. S. O., R. E. (retired), Assoc. Inst. C. E., M. Inst. E. (India), late Chief Engineer, Khyber Railway, and Agent, Eastern Bengal Railway. Published by Thacker, Spink and Co., Calcutta. 1928. Price, Rs. 3.

These two parts give direct calculation of differences in Heights and Distances from Tacheometer Observations. The tacheographs now published reduce the labour enormously in the reduction of the "generating number" and eliminate much chance of error in reduction. Directions for use are given on the tacheographs.

Foreign Notes.

A Diesel-Battery Locomotive.—An interesting development in the railway world is a "self-contained" Diesel-electric locomotive which has recently been put into commission for shunting purposes in the New York Central Yards. In addition to the Diesel generating set, it is also equipped with a 218-cell, 432-volt Exide battery. This is sufficient to supply the driving motors during normal working, and during heavy loads the Diesel set and the battery work in conjunction. When the locomotive is standing, or during light load the battery is charged by the oil-driven generator.

Electricity Supply of South Africa.—The Electricity Supply Commission of South Africa proposes to extend its 33,000-volt transmission line to Paarl from a point near Mulder's Vlei to a sub-station at a convenient point in Stellenbosch, to which point will be connected also an extension from near Eerste River of the 33,000-volt line to the Cape Explosives Works, whence mains at 550 volts, three-phase, would be led to five transformer pillars equipped with auto-transformers supplying the reticulation system with electric energy on the 380-220 volts, three-phase, four-wire system. This will involve altering the whole of the existing direct-current 380-220 volts system to three-phase, at an estimated cost of £4,500; but, on the other hand, extensive additions would in any case require to be made to the distribution system, in view of the increasing demand.

Propagation of Flame in Complex Gas Mixtures.—Data obtained in a study of the propagation of flame in complex mixtures, conducted by the U. S. Bureau of Mines, have made it possible to predict the inflammability of any mixture of hydrogen, carbon monoxide and methane with varying proportions of oxygen, carbon dioxide and nitrogen from a simple analysis of the mixture. The results are of considerable value in connection with mine fires, and in many industrial operations where inflammable mixtures may be present. The inflammable limits of the complex mixture are calculated from the data obtained for the individual gases. Comparison between calculated and observed values has been made on a series of synthetic gas mixtures, including typical blast-furnace gas, automobile-exhaust gas, gases from detonation of explosives in coal mines, gases after coal-mine explosions, and mine-fire gases. Calculated and observed values for inflammable limits check within 1 per cent.

Synthetic Manufacture of Fertilisers.—A new company, which proposes to utilise coke oven gas for the synthetic manufacture of fertilisers, and which is called the Ruhr Chemical Corporation, has been formed by a consortium of twenty-seven of the leading coal and coke companies of the Ruhr, headed by the Vereinigte Stahlwerke A. G. Large plants which are to be capable of an annual production of 300,000 tons of synthetic nitrate are at present in course of construction. The principal plant at Holton, near the Rhine, will, it is understood, be in operation early next year, and nine months later a second unit is to be started, to be followed later by several others. The processes used will be the Concordia-Linde and the Casale processes for the production respectively of hydrogen and synthetic ammonia. The present surplus of coke oven gas in the Ruhr is estimated at over 9,000 million cubic metres annually, which, if fully utilised, is equivalent to an annual production of 1,800,000 tons of synthetic nitrate, *i. e.*, three times Germany's present output. Other important coke oven gas derivatives include a methyl petrol substitute, which it is intended to produce on a large scale.

Port of Itajahy.—The Government of the State of Santa Catharina has concluded a contract for the improvement of the port of Itajahy, the principal outlet of the thriving district in the valley of the Rio Itajahy. The work will include dredging an obstructive sand bar, cutting away the river banks for a distance of several thousand feet, the erection of a breakwater and various other improvements. Simultaneously, the dredging will be begun of the entrance to the port of Florianopolis, capital of the State of Santa Catharina. The cost of these enterprises, both to be completed within twelve months, is estimated at £48,000 and £72,000 respectively. A third contract has been awarded for improvements at Laguna, the principal southern port of the State of Santa Catharina, and the terminus of the Dona Thereza Christina Railway. The contract calls for the extension of the dock to a total length of 780 m., the construction of two additional breakwaters, and the dredging of the channel and the mouth of the lagoon. Important discoveries of coal are reported to have been made in the valley of the Rio Tubarao and the Government of Santa Catharina intends to develop them.

A New Thames Pier.—It is anounced by the Port of London Authority that work will shortly be begun on a new pier at Tower Steps, close to the western extremity of the Tower of London, says the "Engineer." The object of the new pier, which will be probably named the Tower Pier, and will be ready for service next season, is to provide easier navigating facilities for the pleasure steamer traffic which at present uses the Old Swan Pier. As the pleasure steamers have in recent years increased in size, it has been found more difficult to navigate them easily in quick running tides and in a river often filled with traffic. The new pier will be midway between London Bridge and the Tower Bridge, and the steamers will be able to steer directly for it, without having to navigate the narrow and swift currents of a bridge arch. In addition good access to the new site is given from Tower Hill. Many will regret the passing of the Old Swan Pier, which is to be demolished when the new structure has been put into service. Records of that pier go back to the years before 1857 when it was taken over by the Thames Conservancy. That Authority rebuilt it in 1862 and after it had been in the care of the London County Council for a few years, it passed, in 1909, into the charge of the Port of London Authority. It took its name from the *Old Swan Inn*, which is mentioned in Pepys' Diary.

Pennsylvania Pier Terminals Enlarged.—According to the "Railway Gazette," the Pennsylvania Railroad has recently entirely remodelled and enlarged its perishable produce terminals on Manhattan Island, New York. For over 40 years the Pennsylvania has handled this traffic at three piers along the Hudson River water front. The piers, each 1,000 feet long by 75 feet wide, are connected across the shore end by a shed-covered bulkhead 50 feet wide with a frontage of 715 feet upon the main water-front drive of lower New York. In the remodelling, 241,230 square feet of covered plank floor area has been enlarged to 359,530 square feet of covered reinforced concrete deck; the four auction rooms of the old terminal have been increased to eight; heating and lighting have been modernised; and spacious restaurant facilities provided, all at a cost of $1,750,000. All three piers have dock space on both sides throughout their length, the slips between the piers being 140 feet wide. With the enlarged facilities, the Pennsylvania now has capacity for handling approximately 700 cars of perishable produce a day. This traffic is delivered in refrigerator cars or car floats at night. All the produce is received, displayed, sold and delivered the same day, and by late afternoon the decks of the piers and bulkheads are practically cleared ready to receive the shipments of the following day. The produce terminals are supplemented by a new produce receiving, classification and delivery yard recently completed, at Kearny, New Jersey.

The Royal Tweed Bridge.—The Royal Tweed Bridge at Berwick, which was to be officially opened by the Prince of Wales on 16th May, is, according to the "Engineer," now completed as regards the structural work. It has been built to the designs of Messrs. Mouchel and Partners, of Westminster, and the work, which was begun in 1925, has been carried out by Holloway Brothers, of London and Newcastle. The new bridge is of interest as being the longest reinforced concrete road bridge in the country, and its largest span of 361 feet 6 inches is said to create a record in reinforced concrete construction. The bridge has a total length of 1,405 feet and consists of two approach spans and four arch spans. The approach spans have lengths of 144 feet 6 inches and 199 feet, and the four arch spans, which rest on five concrete piers, have lengths of 167 feet, 248 feet, 285 feet, and 361 feet 6 inches, the large span being on the Berwick side of the bridge. The total width of the bridge is 46 feet, and is made up of a 30 feet carriageway and two 8 feet footpaths. There are four arched ribs to each span, and the ribs are hollow from their springing point for a third of the length of the span, the centre portion being solid. From the arch spans vertical supports are carried up to the decking level. The paving of the roadway consists of 2 inches of asphalt laid directly upon the decking. The bridge has masonry parapets and the spans are designed to carry safely a moving load of 1,350 tons. It is stated that the cost of the bridge, part of which will be borne by the Ministry of Transport, will, including the purchase of land and property, probably work out at about £160,000.

The Pyrenees Railways.—Last month there was put into service with great ceremony the first of the two railways which are to open up traffic between France and Spain through the Eastern Pyrenees. The line between Bedous and Jaca has been completed and the other between Aix-les-Thermes and Ripoll will be terminated next year. In 1914 the line from Pau to Orloron was extended to Bedous, and from that point the penetration of the Pyrenees began, the line steadily rising from an altitude of 400 m. along the Gave d'Aspe, which is crossed by three steel bridges and three viaducts. There are no fewer than fourteen tunnels between Bedous and the frontier, the most important being the Portalet, 940 m. long, the famous helicoidal tunnel of 1,750 m., and finally the Somport tunnel, at an altitude of 1,211 m., which is 8 kiloms. long, and of which 3,500 m. are in France and 4,500 m. in Spain. At the southern end of the Somport is the Canfranc international station, which is a very fine construction with a frontage of 300 m. As the Pyrenees are much deeper on the French side the gradients are often very heavy, in some cases as much as 43 mm. per metre, but on leaving the Canfranc station there is only a moderate down gradient for a distance of 25 kiloms. to Jaca, where the existing line to Saragossa is joined. The saving of distance is appreciable and is even considerable for towns like Pau and Toulouse, but the advantage of the railway is expected to lie more particularly in a development of traffic which is at present restricted by lack of transport facilities and also in a more active working of the mineral resources of the Pyrenees.

The Thames Bridge Schemes.—According to the "Engineer," the report of the committee of engineers appointed by the Minister of Transport to consider the scheme for a double-deck rail and road bridge at Charing Cross, as recommended by Lord Lee's Commission on Cross-River Traffic, was published on 9th May. The report is accompanied by full particulars of the alternative scheme which the committee favours, namely, the removal of Charing Cross Station to the south side of the Thames, and the construction of a new high-level road bridge across the Thames in place of the existing Charing Cross railway bridge and the footwalk known as Hungerford Bridge attached to its down-stream side. This scheme also contemplates the widening of the existing Waterloo Bridge, and, altogether, its cost is estimated at £10,770,000, as compared with £11,720,000, the committee's estimate for the Lee Commission's double-deck bridge. It is reported that the committee's alternative scheme is regarded with favour in Government circles, and that the Government would be prepared to contribute from the Road Fund a substantial portion of the 11 million or so required to carry it out. The attitude of the Southern Railway towards the scheme has yet to be disclosed. It may be recalled in this connection that the company's chairman at a shareholders' meeting a year or so ago said that to consent to the transference of Charing Cross Station to the south side of the river would be suicidal on the part of the company. The suggestion of the transference of the Southern Railway's west-end terminus to a site adjoining its Waterloo Station has already prompted the outlining of schemes for developing the tube railways serving the Waterloo area. One such scheme is said to contemplate the construction of a new tube between Waterloo and Victoria.

General Articles.

MODERN SELF-CLOSING STREAM LINE NEEDLE VALVES.

AN INTERESTING EXAMPLE FOR LONDONDERRY WATERWORKS.

WE are able to reproduce on the opposite extremely interesting photographs showing an 18-inch inlet by 9-inch throat automatic, self-closing, stream line needle valve under test in Messrs. Glenfield and Kennedy's private hydraulic station at their Works in Kilmarnock, before delivery to the Londonderry Waterworks in Ireland.

This valve is designed for a working pressure of 400 feet head, comprising cast iron body and piston with gunmetal faces, and the necessary pressure and exhaust piping, together with control cocks and valves and taper pipe on the outlet side, and was tested—as seen in the photographs—to 800 lb. per square inch pressure.

This new type of needle valve is a fine piece of work, and is characterised alike by its extreme simplicity and the positive certainty of closing when called upon. The principle is essentially that of a "Venturi" throat so proportioned as to set up a small differential pressure, and then if the velocity of the water varies in the main this differential pressure also alters in proportion to the square of the velocity. Further, the pressure is utilised to provide the necessary operating power, and in the first place therefore the valve is entirely independent of all complications in the way of trip gear, operating weights, hydraulic cylinders, and mechanical starting gear, the valve plunger being nearly balanced hydraulically but with a positive bias towards closing. There is included in the arrangement a light counterweight attached to the plunger, which is so designed as to overcome this closing bias at the normal rate of flow, but should the latter increase beyond a predetermined figure then the action of the counterweight is overcome and the valve gradually closes itself without shock. That is to say, the stream line valve plunger acts in unison with the stream itself, as it were, tending to float along with the current, and not only does the closing force increase with the velocity of the water but also as the valve approaches its seating, a highly important practical point since of course in the ordinary design of valve there is hardly any operating force as the closing-down stage is approached, due to the diminution of the velocity energy of the current. Other advantages of this design are also that the action of the valve is not affected by breakages or deterioration of any of the parts, nor by leaky pipe joints, while it is impossible for it to fail to come into action under any circumstances.

PRINCIPLES OF ROADMAKING.

BY G. C. BANERJEE, Late Executive Engineer, P. W. D., Bengal, Consulting Engineer, Alipore, Calcutta.

SECTION I.

I. *Classification of roads.*—Roads, according to the nature of their surfaces, facility of transport and drainage are generally classified into the following six groups :—

A. CLASS I—Metalled

(*a*) with bridges or ferries and drained throughout.

(*b*) partially bridged and drained.

B. CLASS II—Unmetalled

(*a*) with bridges or ferries and drained throughout.

(*b*) partially bridged and drained.

C. CLASS III—Banked and surfaced but not drained.

D. CLASS IV—Banked but not surfaced, partially bridged and drained.

E. CLASS V—Cleared and partially bridged and drained.

F. CLASS VI—Cleared only.

II. *Vehicular traffic.*—The wheeled traffic which ply on the roads may be divided into two main heads, *viz.* :—

(*a*) *Those without springs*, that is country carts drawn by a pair of bullocks or a pair of buffaloes. These have wooden wheels fitted with an iron rim.

(*b*) *Those provided with springs*, that is (1) carriages drawn by a pair of horses, and so on. These have as before wooden wheels fitted with an iron rim, and (2) motor cars, lorries, etc., for carrying heavy loads and propelled by mechanical power. These have iron wheels fitted with rubber tyres.

III. *Resistance of wheel-carriages on roads under the influence of speed.*—The resistance which the wheeled traffic experiences on roads is the *force of friction* which tends to resist their sliding. It is, of course, well known "that the static coefficient of friction is greater than the dynamic coefficient of friction. That excess of the *friction of rest* over the *friction of motion* is instantly destroyed by a slight vibration," and we are here mainly concerned with the *friction of motion.*

The resistance of wheel-carriages on level parts of road surfaces was investigated by General Morin, Sir John Macneill and others and it was found to be a fraction of the load drawn, the proportion depending upon the nature of the material of which the road surfaces were made up, the diameter of wheels and the rolling speed.

The total resistance (R) was found to consist of two parts, R_1 and R_2.

The first part R_1 which arises from *friction*, is constant for all speeds, but varies directly with the nature of the road surface and the load drawn and inversely as the diameter of wheels. This part is then expressed by the formula $R_1 = \frac{a}{r} L$

where a is a constant for the road surface
r the radius of the wheel in inches
L the load drawn.

The second part R_2 which arises from vibration, is found to vary directly as the speed, the mechanism of the vehicle and load drawn and inversely as the radius of the wheels as before and for vehicles provided with springs this part is represented by the formula

$$R_2 = \frac{b\,(v - 3{\cdot}28)}{r} L$$

where b is a constant for the road surface
r the radius of the wheel in inches and
L the load drawn.

For carriages without springs the constant "b" is about $3\frac{1}{2}$ times greater than for those with springs and thus the total resistance R_1 may be expressed by the formula

$$R = R_1 + R_2 = \left\{ \frac{a + b\,(v - 3{\cdot}28)}{r} \right\} L$$

$$\text{or} = \left\{ \frac{a + 3\frac{1}{2}\,b\,(v - 3{\cdot}28)}{r} \right\} L$$

according as the vehicle is fitted with springs or not, and having values depending upon the values of the five quantities a, b, r, v and L.

For good broken roads the constants "a and b" have mean average values of 0·4750 and 0·0250 respectively.

The radius "r" is different for different classes of vehicles. But as the resistance is inversely proportional to the radius it would be seen that the damaging action of wheels on roads "is greater as the diameter is less and is less for bigger wheels."

The diameter of wheels of heavy lorries are limited to 2 feet 6 inches while the diameter of the bullock and buffalo carts vary from 4 feet to 5 feet. Vehicles are also met with whose diameter occupy intermediate places.

The law of dynamic friction between two bodies as deduced from Napier's experiments is generally known to be a function of the force with which they are pressed together, that is the gross load and their relative velocity of motion and for dry unlubricated surfaces the friction increases with the velocity up to a certain maximum and then diminishes.

It will be seen from the experimental results of the influence of speed on the coefficient of friction that the resistance increases up to a speed of about 8 miles per hour and then gradually diminishes.

The values of R_1 on a level part of a good broken stone road for various diameters of wheels varying from 2 feet 6 inches to 5 feet are given in column I of the "Table of Resistances," the mean average being 0·02232 or 49·9968 lb. per ton of load drawn.

Table of the Resistances of wheel-carriages on a level part of a good broken stone road.

	COL. I.		COL. II.								
	$R_1 = \frac{a}{r} \times L$ where a = 0·4750, r = radius of wheel *in inches*, L = Load drawn		For vehicles *fitted with springs* $R_2 = b\left(\frac{v}{r} = 3-28\right)$ where r = radius of wheel *in inches*; b = 0·025, v = velocity in feet per second L = Load drawn.								
	r	$\frac{a}{r}$	2 miles per hour.	3 miles per hour.	4 miles per hour.	5 miles per hour.	6 miles per hour.	7 miles per hour.	8 miles per hour.	TOTAL.	—
	15"	0·03167	0·00058	0·00187	0·00433	0·00676	0·00922	0·01167	0·01411	0·04738	
	18"	0·02639	0·00049	0·00156	0·00360	0·00567	0·00767	0·00972	0·01175	0·03948	
	21"	0·02262	0·00042	0·00133	0·00308	0·00482	0·00657	0·00832	0·01006	0·03376	
	24"	0·01979	0·00036	0·00116	0·00269	0·00421	0·00574	0·00727	0·00870	0·02950	
	27"	0·01759	0·00032	0·00104	0·00241	0·00377	0·00513	0·00650	0·00786	0·02639	
	30"	0·01583	0·00029	0·00093	0·00215	0·00336	0·00458	0·00580	0·00701	0·02354	
Total ...	.....	0·13389	0·00246	0·00789	0·01826	0·02859	0·03891	0·04928	0·05958	0·20005	
Average .	......	49·9968	0·9184	2·9456	6 8171	10·6736	14·5264	18·3979	22·2434	......	lb per ton.
Gross $R_1 + R_2$	......	....	49·08	52·94	56·81	60·67	64·52	68·39	72·24	......	,,

Average value of R_1 = 49·9968 lbs. per ton.

" " " R_2 = 10·6624 " " "

" " " R_1+R_2 = 60·6592 lbs. per ton.

For vehicles without springs :—

Average value of R_2 = 37·3184 lbs. per ton.

" " " R_1+R_2 = 87·3152 lbs. per ton.

Mean for the two classes —73·9872 lbs. per ton = 1/30th of a ton only.

The values of R_2 for different speeds varying from 2 to 8 miles per hour are also shown in column II of the same Table, the mean average being 0·00476 or 10·6624 lbs. per ton. This is for vehicles "with springs."

For vehicles "without springs" the mean average value of $R_2 = 3\frac{1}{2} \times 0{\cdot}00476 = 0{\cdot}01666 = 37{\cdot}3184$ lb. per ton.

Thus the total resistance $R = R_1 + R_2$ for the two classes of vehicles works out to 0·02708, or 60·6592 lb. per ton and 0·03898 or 87·3152 lb. per ton, giving the average for the two classes as

$$\tfrac{1}{2}\,(60{\cdot}6592 + 87{\cdot}3152) = 73{\cdot}9872 = \frac{1}{30} \text{ nearly.}$$

The result agrees perfectly well with that of Telford who estimated the average resistance of carriages on a level part of a good broken stone road as "one-thirtieth of the gross load."

With the help of the above table the resistance experienced by a vehicle with known diameters of wheels and speed can be calculated as shown below :—

1. By a *buffalo cart* (without springs) Diameter of wheels—5 feet 0 inch; Speed—2 miles per hour. Resistance $R = R_1 + R_2 = (0{\cdot}01583 - 3\frac{1}{2} \times 0{\cdot}00029) \times 2240 = 33{\cdot}17$ lbs. per ton.

2. By a *heavy lorry:* (with spring). Diameter of wheel—2 feet 6 inches; Speed—8 miles per hour. Resistance $= (0{\cdot}03167 + 0{\cdot}01411) \times 2240 = 10255$ lb. per ton.

The average resistance of wheel-carriages on level parts of good broken stone roads for speeds of 2 to 8 miles per hour are shown at the bottom of column II of the same table and it will be observed from the figure given therein that "the increase of resistance is quite proportional to the increase of speed," and the locus thus represents a straight line up to a limit of 8 miles per hour.

The law according to which the resistance decreases beyond the limiting speed of 8 miles per hour was investigated by M. M. Bochet and published in the "Comptes Rendes" of the French Academy of Science in 1858 and may be expressed by the approximate formula

$$R = \frac{\mu L}{1 + \alpha v}$$

where R = Resistance

L = Load drawn

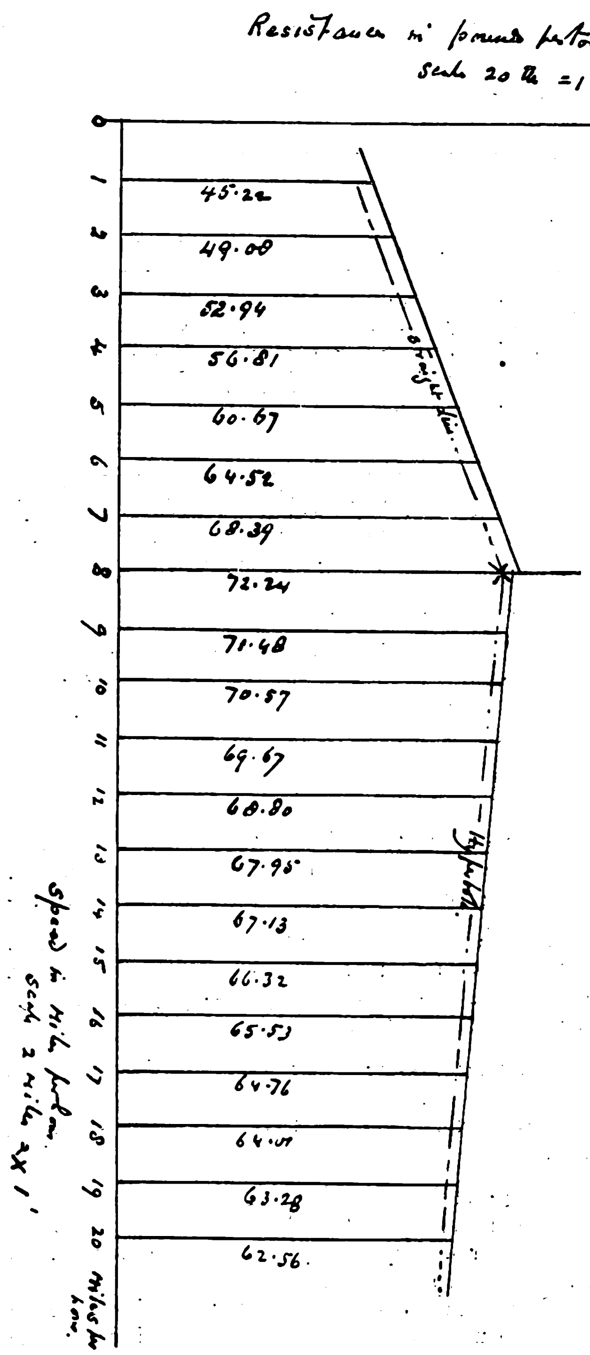
μ = a constant having a value of 80·9088 approximately.

α = 0·01 newly

v = velocity in feet per second.

The equation evidently represents a "hyperbola" referred to its *asymptotes* as the axes of co-ordinates. The resistance gradually diminishes, but it can never disappear since the axes meet the curve only at infinity.

The increase and decrease of resistance are graphically represented in the diagram given below:—



Graph of the Resistances of Wheel-carriages on a level part of a good broken stone road under the influence of speed.

(*To be continued.*)

STEAM BOILERS.

WHILE the rapid development of steam engineering practice in the direction of higher pressures and temperatures continues to raise new and serious questions in regard to the design and materials to be adopted in order to meet the new conditions, there is still room for improvement in regard to the practice for the existing well-established ranges of pressure and temperature, writes the "Metallurgist." Failures of boilers working under quite ordinary conditions, although fortunately rare, are not unknown, and their study and prevention is all the more important in view of modern developments. Much attention has been given in recent years, especially in Germany and America, to the phenomenon of cracking around rivet holes, which is characterised by the formation of great numbers of inter-crystalline fissures. Under the very unsatisfactory term "caustic embrittlement," this has been ascribed to the chemical attack of concentrated caustic soda solutions formed by the evaporation of the boiler water in slightly leaky seams, but the simultaneous action of severe stress is also essential. It is interesting to remark, that if the explanation of Parr and Straub as to the causes of this type of cracking are correct, alternating stress—*i. e.*, bending backwards and forwards of the steel near the seam—need play no part in the process. In the experiments of Parr and Straub the cracks were developed under the action of direct stress.

We emphasise this point in view of the suggestions often heard, and recently reiterated by Mr. Strohmeyer, that boiler failures are frequently, if not always, the result of the "breathing" or thermal working of the boiler leading to flexure at the junction between parts of different stiffness or differently held. Mr. Strohmeyer goes so far as to suggest that greater flexibility in boiler construction, even if achieved at the expense of actual strength by the reduction of thickness of the plates, is likely to lead to better results. There is, in itself, nothing impossible about such a suggestion. Cases are well-known where repeated failures have only been avoided by a reduction of scantling, leading to a more flexible construction. If, however, at the same time, the use of a softer material of lower elastic range is advocated, there would seem to be some little confusion of ideas. The use of too stiff a construction is disadvantageous, where the forces at work are such that a certain definite amount of deflection must occur in spite of any resistance the material can offer. If a plate must bend through a given angle, whatever its thickness, then the thinner the plate the lower the stresses which will be devoloped in it when thus bent. Greater thickness and stiffness will only become useful if it can actually prevent the bending from exceeding a much smaller amount. This, however, applies essentially to bending or other stresses of an elastic nature. If the material is obliged to yield to the bending by undergoing plastic deformation of an appreciable amount, our knowledge of the behaviour of ductile metals enables us to predict what must occur if the bending process is repeated sufficiently often. Either the material will harden under the repeated cold working, and will ultimately possess an extended elastic range which will no longer be exceeded by the deformations forced upon it or the material will ultimately fail under fatigue.

Two important reservations are, however, necessary here. The first is that fatigue is a slow process where the alternations of stress are not very rapid. For that reason a piece of soft metal, such as wrought iron or very mild steel, may undergo repeated bending far beyond its true fatigue range for a very long time, unless the bending is repeated many hundreds of times per minute. A stress must be very far above the fatigue range to bring about fracture before it has been applied and reversed some 40,000 times. The

thermal working of a boiler is probably not a frequently repeated phenomenon, so that 40,000 repetitions would represent a very long life. Here, however, our second reservation comes in, to the effect that where metals, and especially steel, are exposed to mildly corrosive conditions, the combined effect of corrosion and fatigue is much more serious than that of either alone. There is every reason to think that such combined conditions occur in boilers. There is the well-known phenomenon of "grooving" which is often found, not actually in the riveted seams, but near joints where differences of stiffness cause a concentration of bending. This phenomenon is not quite like that of "corrosion fatigue," as recently studied by McAdam, perhaps because the conditions of slow alternating bending and of rather more severe corrosion, coupled with a higher temperature, may lead to a larger amount of chemical action—actual removal of metal—and to less fatigue, *i. e.*, less tendency for the formation of cracks. Whether this is a correct interpretation of the facts has yet to be established by research, but it is at least an entirely open question whether the solution of the problem lies in the use of very ductile material of relatively low tensile strength and low fatigue range or in thinner sections of materials of much higher fatigue range. Possibly, too, the real solution may be found in a radical alteration of design in such a way as to reduce the concentrations of bending by keeping the whole boiler structure at a more uniform level of stiffness, or, alternatively, by making provision for these changes of shape and dimensions by definitely providing adequate flexibility within the elastic or at least the safe fatigue ranges of the materials. Our knowledge of the properties of materials under deformation, fatigue and corrosion fatigue has by no means reached finality, but certain very definite advances have already been made. Some of them, as we have tried to indicate, have a direct bearing on the problems which arise in steam boiler construction, and it is only when they are fully taken into account that useful improvements on current practice can be expected.

TROPICAL CULTIVATION.

THE various methods of cultivation found in the tropics afford very striking contrasts. In some parts the most primitive implements are still considered satisfactory, whilst in other countries very intensive systems of cultivation have been evolved. Ploughing is the principal, and in some instances the only operation carried out in preparing the soil, and the ploughs in use range from the small native type weighing, say, about 30 lb. complete, and drawn by two very small oxen, to the highly efficient tractor plough fitted with all modern labour-saving devices, and weighing from about a quarter to a half ton and even more. Incidentally it may be mentioned that in parts of Ceylon even ploughing is dispensed with, oxen being driven through land previously flooded, until it is sufficiently churned up by their hoofs.

Dealing first of all with India and other Eastern countries which have their own methods, it may be said that the majority of ploughs in use are fairly light and are usually with beam and handles of wood. A typical Indian plough is the "Monsoon," made by Ransomes, Sims and Jefferies, Ltd., of Ipswich, England. This plough has share and breast of cast chilled metal, the former having a renewable point. A similar plough is the "Jat," made by the same firm, which turns the furrow to the right instead of the left. Other types of plough used in the East include those with steel bar-point shares for breaking up land on which a hard crust forms, previous to the rainy season, very light all-steel ploughs which may in time supersede the wood-beam ploughs mentioned above, turnwrest ploughs which turn all the furrows one way and leave no open furrows, while for the black cotton soil much stronger ploughs are necessary, these being either of the single-furrow type for animal draught, or 2 and 3-furrow ploughs drawn by tractors.

In discussing other tropical countries, it may be better to deal with each crop separately.

SUGAR CANE.

The operations connected with the cultivation of this vary considerably in different parts of the world. Where possible a fairly heavy plough, working to a depth of 10 or 11 inches, is the most satisfactory, and Ransomes' "President" 2-furrow tractor disc plough, suitable for furrows up to 10 inches wide by 11 inches deep, has been used with considerable success in Natal, Mauritius and other cane growing countries. In some places, however, such as the Straits Settlements, it is necessary to use a lighter type of plough on account of the very soft nature of the soil. Sugar cane is planted in rows, the distances between these varying from 4 to 6 feet, according to the richness of the soil, and before planting the land is usually arranged in ridges and furrows by means of a ridging plough or a two-row or three-row ridger. Messrs. Ransomes, Sims and Jefferies, Ltd., offer numerous implements of this type which can be fitted with bodies of various patterns to meet the requirements of planters in different countries. The cane slips are generally planted on the side of the ridges, but in well-drained land it is sometimes found advantageous to do the planting in the bottom of the furrow. Again, it is in some places the practice to plant the cane on the level and to mould it up as it grows. This latter operation can also be performed by means of a ridging plough. Cultivating between the rows of growing cane is generally essential, and should be continued until the growth of the cane is sufficiently far advanced to choke the weeds. This work can be very efficiently carried out with a special narrow cultivator with 5 or 3 tines, such as the "Dauntless," or with a Ransomes' expanding disc harrow.

COTTON.

With cotton, as with sugar, the cultivation of the land prior to the actual planting, is of great importance. The land should be ploughed all over to a good depth and all grass, roots, etc., removed. Messrs. Ransomes offer a very wide selection of ploughs, both share and disc, for this work, suitable for both animal or tractor draught. The continuous use of a disc harrow, such as the "King" pattern, is also recommended both before and after ploughing. Cotton is sown in rows, on an average about 4 feet apart, and the seed is usually sown by means of a cotton planter, such as the "Pilot," either single or double row. It can be done continuously, when the seed is sown in a continuous stream, or by space planting, when bunches of seed are dropped at fixed intervals, say, about 18 inches apart. In some countries cotton is sown on ridges, but usually on the flat, which has been found equally satisfactory in most cases. For tractor work two of the double-row planters can be coupled together, and this obviously means a considerable saving in time and labour. The planters can be fitted, if desired, with attachments for distributing artificial manures. Cultivation between the rows whilst the cotton is growing is essential, and for this work Ransomes, Sims and Jefferies, Ltd., provide a light steel cotton hoe consisting of a pair of L hoes attached to a frame similar to that of a light ridging plough. Another implement for this work is their expanding disc harrow. The importance of frequent cultivation between the rows, especially in dry weather, cannot be over-estimated.

TOBACCO.

In the cultivation of tobacco, where new land is being used, it is advisable to clear and plough the

land during or before the rainy season previous to planting. If the soil is properly ploughed at the time all weeds and other vegetable matter will be turned in and the richness of the soil will be greatly increased. In the case of land already under cultivation, this should be broken up as soon as possible after the crop is removed. Ploughing in the case of tobacco should turn only the surface layer of soil, as it is important that the subsoil should not be brought to the surface. Both with new and old land a second ploughing is desirable, and the soil should then be brought into a fine tilth by means of harrows, disc harrows or land rollers, according to the type of land. Messrs. Ransomes manufacture a large number of ploughs suitable for both first and second ploughing, and also the necessary implements for further preparation where desired. Tobacco may be planted on ridges or on the flat, the former being advisable if there is any possibility of the soil becoming waterlogged. In most cases ridges are recommended, and these can be made with the ridging ploughs or ridgers mentioned under the heading of sugar cane, suitable bodies being provided for the type of ridge required. Cultivation should be commenced as soon as transplanting has taken place, and this can be carried out by means of a light cultivator if the plants are on the flat, or with a hoe or expanding disc harrow if on the ridge. The number of cultivations necessarily varies with the soil and climatic conditions, but the main objects should be, as in the case of other crops, to prevent the growth of grass and weeds between the plants and to maintain a fine loose mulch on the surface of the soil.

Other tropical plants, each requiring its special methods of cultivation, are rice, tea, maize, sisal, coffee, etc., but space will not permit of dealing with these in this article.

THE SENNAR DAM.

SLUICES AND MACHINERY OF THE GEZIRA IRRIGATION SCHEME: BLUE NILE DAM AND CANALISATION.

AT a meeting of the Institution of Civil Engineers, held on 17th April, Mr. J. R. Russell, A. M. Inst. C. E., presented a paper on the "Blue Nile Dam and Canalisation." He said that the intention is to irrigate about 300,000 acres of the Gezira district of the Sudan, about 100 miles S. S. E. of Khartoum. The Sennar dam, 3,250 m. long, spanning the Blue Nile at Makwar, forms a reservoir from which water can be drawn when required into the main canal which carries it to the area to be irrigated. At the site of the dam a ridge of rock crosses the course of the river at no very great depth, and outcrops at one point to form a small island which divides the river into two channels. To prevent siltation the silt-laden summer flood is passed through the dam with a low reservoir level, and the river above the dam is confined as much as possible to its normal channel.

To this end the dam is pierced by eighty culverts, 2 m. wide by 8·4 m. deep, each of which houses a sluice of the "Stoney" free-roller type, very similar to those used in the Assuan dam. The sluices consist of gates built up of mild steel plates and rolled joists working in cast iron frames built into the masonry. The water-pressure is transmitted from the gates to the frames and piers through mild steel free rollers.

The gates are stanched by adjustable steel bars bolted to the skin plates. Suspension is by means of short-link chains. These main sluices are operated by two petrol-driven machines which travel on tracks laid on the parapets of the dam. One of these machines is fitted with a revolving jib and is capable of operating a curtain which can close the mouth of a culvert should any of the sluices become jammed by logs or other obstructions. The flow of water to the main canal is controlled by seven sluices similar in design to the river sluices, 3 m. wide by 5 m. deep, each sluice being operated by a separate hand crab.

The first of the groups of regulators that control the flow of water in the main canal and into the distributaries is 57 km. down the main canal. In the main canal regulator at this point are six sluices of the double-gate type, fitted with circulating rollers. Each sluice is 3 m. wide by 5·05 m. deep. At the head of an escape channel to the river is a barrage of three similar sluices. Further down the main canal, at km. 77, is a main canal regulator of four sluices and an escape regulator of three sluices, identical to those at km. 57. At km. 99 there are two sluices, and at km. 108 three sluices, all 3 m. wide but rather shallower than the others. Certain of the smaller sluices in the northern area are of the sliding, non-roller type, operated by worm and rack gear.

It was expected that the sluice frames would have to be erected hurriedly during a few short periods, and special equipment was provided to enable the work to be tackled speedily and effectively whenever opportunity offered. This tackle was designed to deal with the tendency to spring which is common to all large machined iron castings, and to facilitate their being brought into exact alignment. The plumbing gear was arranged to shield the plumb line and bob from air currents, and to permit of the detection of an error of less than 0·005 inch. Special slings and lifting-bridles were provided to hang the frame castings from the crane hooks vertically or horizontally as required. The frame castings were erected in recesses left for them, after the neighbouring masonry had been built, the spaces being then grouted up. During erection the sill castings were suspended in their recesses on screws by which they were levelled. Some difficulty was experienced in erecting the frames owing to the effect of the wide temperature variation.

The erection of the sluice work was commenced in the beginning of 1923. The first season's work, to July 1923, was confined to the built-in parts of the canal head-regulator and to the preparation of a suitable yard and workshop for the coming seasons.

The Gazettes.

Bihar and Orissa, May 30, 1928.

Public Works Department.

Babu Chinta Haran Banarji, Assistant Engineer, Ranchi Division is granted leave on average pay for one month, with effect from 1st May 1928.

Irrigation Department.

Mr. Mohan Lal Bahl, Assistant Executive Engineer, who was attached to the office of the Superintending Engineer, Son Circle, at Arrah, is transferred to the Champaran Division.

Punjab, June 1, 1928.

Irrigation Branch.

Mr. W. Bwye, I. S. O., Assistant Secretary to Government, Punjab, Public Works Department, Irrigation Branch, is allowed leave on average pay for three months and twenty-five days and in continuation leave on half-average pay for two months and six days, or six months in all, with effect from 11th May 1928.

Khan Sahib Sheikh Shah Muhammad, Superintendent, Punjab Irrigation Secretariat, is appointed as Assistant Secretary to Government, Punjab, Public Works Department, Irrigation Branch, on probation, with effect from 28th May 1928.

Mr. F. G. Beck, Temporary Engineer, attached to the Delhi Division, Western Jumna Canal, took over charge of that Division on 28th April 1928 from Mr. J. D. Jackson, Executive Engineer, transferred.

MR. SYDNEY M. JACOB.

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INDIAN ENGINEERING.

SATURDAY, JUNE 16, 1928.

MR. SYDNEY M. JACOB.

I.

IN our series of memoirs of engineers, architects, and officers of the scientific services of India who have done valuable work for the country in their various ways, members of the Indian Civil Service have either not appeared, or if they have found a place at all, it has been in some connexion other than in that kind of technical work with which our journal is concerned. And that of course can be understood. Civil officers have their own special duties, very important duties, which occupy their whole time to the exclusion of other affairs. Still, it is perhaps a little remarkable that they should be so much of the same pattern. They have all passed a high-class examination, which merely means that form of ability which enables a man to pass examinations, and it does not necessarily mean ability of a high order. Marks at an examination, and all that marks represent, are often enough negligible in the sum of human endeavour. They imply a good mechanism for learning, possibly by means of a tenacious memory, rather than effectiveness in the competitive life of the world. But all the same it is idle to say that among the ranks of competition-wallas there have not been brilliant men, apart from any question of brilliance in scholarship. We know that there have, and therefore it would be expected that among the young fellows who enter the Indian Civil Service there would be a greater degree of differentiation. But they themselves apparently prefer to be of a pattern, like so many Eton or Harrow boys to whom any eccentricity of garments or demeanour would be deplorably bad form. They may be good and reputable, and even dull, in their routine duties, without losing their claims for official advancement; but a man who displays originality and imagination is liable to be regarded as a peril and a mischief, like a piece of grit or some foreign ingredient which has found its way into the cog of a machine and is likely to throw it out of gear. The temper of a crowd, it has been said, is something quite different from the sum of the tempers of the individuals who compose that crowd, and that has a bearing on the point; but besides, as Dr. Inge remarked the other day, the herd instinct in man is like the herd instinct which causes a flock of animals to turn upon one of their number who shows any peculiarity. We are all familiar with the behaviour of a herd of cattle in a pasture, they graze and whisk their tails to keep off the flies, twenty or a hundred of them behaving as one. But if an intelligent cow in the herd, irritated by insect annoyance, invented a tail attachment which would be a more effective form of whisk, she would probably be gored to death. It is after that manner that the majority of mankind take it as a personal injury if a member of their body breaks away from established custom.

But however that may be, the Indian Civil Service came to possess, in Mr. Sydney Montague Jacob, a man who by natural structure of mind had quite a different sense of relative values. A son of Colonel Sydney Jacob, R. E., an engineer of very conspicuous abilities who so sanely shaped the destinies of irrigation in the Panjab of his day, he was born in 1879, and passed for the Indian Civil Service, mainly in mathematics and the science subjects, in 1902. Educated at the University College, London, prior to the examination, and again at the same college for his year of probation, 1902-03, he became, with other students of that time, permeated with the idealism of that particular period. In 1900-03, Karl Pearson, William Ramsay, M. J. M. Hill and Soddy were lecturing, and the atmosphere was full of talk of Argon, Alpha, Beta and Gamma particles, Radium and Uranium emanations, Trouton and Noble's ether-drift experiments, Porter's 20-minute researches on odd bits of paper in the Physics' Laboratory, Karl Pearson's correlation coefficients, scientific matters of that kind, and the more gifted of the students were actuated by very real enthusiasm. They wondered, the discovery of a new truth being to them the summit of a man's ambition, which among them would first succeed in some great fundamental research. They were young and had all the strength and faith and illusions of youth; there was no fear that the stormy road of knowledge would lead them, as it led Galileo, to the Inquisition; a great ocean lay before them to explore; and they regarded it as axiomatic that new truths could always be discovered in an unending series. Mr. Jacob in those days made a small discovery in the theory of irrational numbers which was published in the Proceedings of the London Mathematical Society, and he had calculated some of the propositions required to determine the probable error of Karl Pearson's new coefficient of skew correlation.

It was a good beginning, and it was in that spirit of enquiry that Mr. Jacob arrived in India in 1903. He was a fine mathematician, but that was nothing unique, there have been a good many great mathematicians in the Indian Civil Service, including some few Senior Wranglers. He differed from the rest, however, because he did not regard mathematics as an end but a means to an end. It was not that his mathematical and scientific training was useful to him for the purpose of a Government appointment and a pension on retirement, he was a born scientist, and he appears to have supposed that in a service of highly-educated men researches—at any rate those with a practical bearing—would be approved and encouraged. With the idea that there might be an opportunity to continue Risley's anthropometric work in possibly unsurveyed country, he was presented by Karl Pearson with a head-measuring instrument, and he provided himself with a sextant. But little did he know of his own service, though disillusionment began to come fairly soon. There is a story that about six months after his arrival in India he appeared for a departmental examination, and on the eve of the Treasury paper he discovered a method of forming magic squares of order 2^n by the simple process of tearing up paper and transposing the numbers, so he forgot all about the examination and suffered a loss in salary, as his explanation was not considered satisfactory. It could hardly have been satisfactory, and a Sir Isaac Newton in the Civil Service, if he had seen the apple drop and therefore neglected a "potty" Treasury examination in order to study the laws of gravitation, would have suffered also. The Civil Service is proud of its mathematicians, but there is such a thing as red tape, which means the doing of things in an orderly manner, and even a Senior Wrangler must comfort himself like all the other animals of the herd. A man, who frivols with magic squares, and Quantics enabling him to give a rapid proof of the Hessian reduction of the cubic to the sum of two cubes, is unorthodox and must be trampled upon.

(To be continued.)

"BIFFIN."

We regret to have heard of the death of Mr. Charles Henry Holme, M. Inst. C. E., who, for some reason unknown, was called affectionately "Biffin" by his contemporaries and intimates. Mr. Holme was an engineer of the third Coopers Hill year and entered the Royal Indian Engineering College in 1873. His father, a man of some means, owning property in the north of England, at that time resided near Bath in a house overlooking the Avon River and the Kennet and Avon Canal. He possibly did so for the sake of the schools for the education of his family, and there young Charles Holme, with his stature (he was very tall man) and his clean-cut features and curly yellow hair, was a conspicuous figure. It is not known why he adopted the engineering profession, but it is probable that he was more attracted to Coopers Hill than to engineering. There were some notable Coopers Hill men at Bath in those days, and Coopers Hill had a glamour. The first prospectus with its glittering bait had drawn to the College on its opening a number of fine young fellows, and it was only in later years that they discovered how their faith in the promises of Government had been misplaced. In the first few years, however, Coopers Hill was a lure, it was believed to offer splendid prospects in India, the College had a great reputation for prowess in Rugby Football, there had rarely been so many young men in one institution excelling in scholarship and sports, and Mr. Holme, who might have done better in some other walk of life, appeared in and passed the competitive examination of 1873. He was not high on the list of the final examinations, but acquitted himself creditably, and on receiving his appointment to the Public Works Department of India was posted to the Buildings and Roads branch in the United Provinces. His early service was spent at Saharunpore and Dehra Dun, and later at Naini Tal

he built the Ramsay Hospital and other works of some importance. There is no reason why he should not have done well if he had served his full time in India, he had good all-round abilities, was a fine sportsman, especially at big game, and was very popular. But promotion in his time was at its very worst, and he was an assistant engineer, for no fault of his own, for some fifteen years. So when his father died and he, as the eldest son, inherited the family landed property in Berwickshire, he decided to retire. From that time onwards he interested himself in local duties and rarely visited the south of England or troubled to renew his friendships with engineers in India. He was married twice, his first wife, the pretty Miss Phillips of Bath, famous for its pretty girls, died in tragic circumstances at Dehra Dun, and in later years he married again. Two of his gallant sons were killed in the same week in 1914 at the beginning of the Great War, and that no doubt saddened him, though with his reserve of character he never spoke of his sorrows. But the senior Coopers Hill men will not readily forget "Biffin," they had a genuine affection for him at the College and in India, and they will be sorry to hear that he has gone.

WILLCOCKS ON BENGAL.

II.

SIR WILLIAM WILLCOCKS' scheme includes the construction of a barrage of Egyptian type on the Ganges which, at the site he fixed for the work, is a great stream. The length of the barrage was given at 6,460 feet between abutments, and there would of course be a lock; there would be 180 openings of 25 feet each, 162 piers of 10 feet, and 17 abutment piers of 20 feet. The piers would be 45 feet high and carry a roadway. Stoney gates, fitted with vertical hit and miss sliding panels, so that the current of the river would be broken up into many vertical fillets, would be the regulating apparatus. Over the floor, down-stream of the barrage, it was calculated that a flood of 2,000,000 cusecs would pass with a depth of 40 feet and a velocity of 8 feet per second. The cost of the work, including training works, was put at £12,000,000, and Sir William considered that one barrage would suffice for the whole of Central Bengal. In addition to that item, there would be the canals of the cost of which no indication is given; the various protective works for keeping the Ganges to a stable channel and to prevent the silting up of the Bhagirathi; and there would further be the operations in Western Bengal, where, it is said, a red water famine has overtaken Burdwan. Indeed, it is mentioned that the prior claims to public funds are those of the proprietors of the lands on the left bank of the Damodar. The rich red water of the Damodar is said to be their heritage, and they have been cut off from it and reduced to poverty and to the afflictions of malaria. Altogether, the complete project in accordance with the wide sweep of Sir William's conceptions would be one of great magnitude and expense; and any first estimate might not be very accurate as the fighting of rivers and the doubtful issues involved are uncertain factors. It would need a Chief Engineer of Sir William Willcocks' courage and abilities to cope successfully with it, and at seventy-six years of age he could hardly be expected to undertake the task.

There is, moreover, the finance side of the question. In that aspect, Sir William has been accustomed to think on the lines of the conditions of Egypt rather than of those of India. In Egypt the framers of irrigation projects have not been troubled with the stumbling-block of the definition of a productive public work. The cost has to be estimated in order that funds may be provided, but the anticipated returns on the expenditure would not seem to enter into the calculations. It is assumed that a scheme must be remunerative, and in Egypt there are reasons for that assumption. The main revenue of Egypt is derived from a single land and water tax, it is a combined tax, there are no water rates, and there can be no tax on sterile, unirrigated sand. But as soon as the flood waters of the Nile, laden with fertile sediment is applied to it, the land immediately becomes sufficiently productive to enable it to bear the necessary taxation. Sir William alludes to these matters in his valuable work on Egyptian Irrigation; the projects, he says, are conceived in a broad and statesmanlike spirit; the tract concerned benefits by irrigation, and if all do not benefit equally, the poorer people benefit by the wealth of their more prosperous neighbours from their power of spending money and paying higher wages. Besides, the Government does not consider direct receipts only, increased transport of railways, increased imports of necessaries, increased use of duty-paying luxuries like tobacco, and the improved well-being of the population are taken into account. And it has to be admitted that the system suited Egypt; in the forty years during which a capable staff of British engineers improved the irrigation of the country, the revenue rose from £9 to £34 millions, and a bankrupt Government had a large Treasury reserve. In Egypt, the end certainly justified the means. But, although Sir William would apply the same procedure to India, it does not necessarily follow that it would be equally successful there. To accept any and every irrigation project in India as bound to be highly profitable might in some cases lead to disappointing, even disastrous, results; and the usual process of preparing projects, to show the expenditure contemplated, the probable irrigated area, and the anticipated returns on the capital outlay, is not without sense. It has at any rate the merits of salutary checks on the advancement of ill-considered schemes.

To turn then from these general considerations to Sir William Willcocks' project recommendations for Bengal, he did not touch on the finance point, it was not in fact any concern of his, he was merely concerned with the improvement of the agricultural and malarial conditions of the country. But for a scheme of that magnitude there would have to be a loan and the interest charges on the loan would have to be met. It

would not be fair to meet them by general taxation for the benefit of a particular community, however important the welfare of that community may be, and there cannot be water rates. Sir William says that there should be no water rates just as there are no water rates in Egypt, as basin and overflow irrigation are impossible with water rates. It is practically impossible, by inspection in the rice fields, to decide which fields received only flood water, which half flood and half rain, or which only received rain water. Nor, Bengal having a permanent settlement, can there be an increase in the land revenue rates. There could only be a tax on landlords for the betterment of land by special legislation, and that should give no insuperable difficulties. The difficulties in that respect should be considerably less than those on the engineering side. But that does not mean that the scheme should not be attempted, it is not, as Sir William said, a "hole and corner patchwork doomed to failure like the ridiculous Midnapore and Eden Canals which lose money and play at irrigation, whatever else they may profess to do." It is a great scheme on spacious lines, and if it can be carried out there can be little question that the benefit to Bengal would be incalculable. The situation from the point of health is bad enough, malaria is sapping the health of the people and exacting a great toll of life, and from that point of view alone no beneficent Government can afford to be apathetic. But there is also the agricultural situation, and Sir William Willcocks contends in the most emphatic language that the main aim should be to give Bengal plentiful supplies of the rich red water of Ganges floods to enrich the soil and to combat malaria. Anæmic men and anæmic plants, he says, go together, and although he visited Bengal ostensibly to advise on the malaria question, he is of opinion that the restoration of the ancient irrigation of the province is the first step to take, and in that it seems impossible to disagree with him. In the few weeks he had to examine the data on which to base his advice, he made the utmost use of his time, and has left no doubt as to the action he holds to be essential. His counsel involves expenditure of money, legislation and engineering skill, and the responsibility of taking advantage of it now lies with the Government of Bengal.

DOMES.

We can hardly help being interested in domes in India, and therefore the chapter on Domed Styles in Mr. Heathcote Statham's work, "A Short Critical History of Architecture," makes an appeal. The history of dome architecture is a little confusing, in the West it may be usual to associate it with the Byzantine style, and in that style there is the outstanding example of St. Sophia at Constantinople. It was the fourth church on the same site. The first dome, with a diameter of 108 feet and an axis of 40 feet, fell; in the second the axis was increased and it was still too little; the third church was burned down; the fourth stood, and until the interior decorations, always a feature of Byzantine art, were whitewashed and defaced by the Mohamedans it was one of the most wonderful interiors of the world. As Mr. Statham says, what the Parthenon of Athens is to columnar architecture, so is St. Sophia to domed architecture.

But there were domes in Europe and in Asia long before that of St. Sophia, columns had been spanned by arches instead of architraves and even the pendentive was not new. All that can be said is that in the Byzantine church these features were given supreme astistic expression. There were domed buildings erected by the Romans, amongst them the Pantheon, one of the grandest domes ever built; and it is perhaps a little curious to read that Mr. Statham says that we cannot speak of Roman architecture under the heading of the domed styles because, with the Romans, the dome was only introduced as a roof for a building in a circular form. He says that the erection of a dome over a circular plan is no solution of the problem of domed construction, and that the real problem was only solved when men had learned to build circular domes over square compartments. It is a little difficult to agree altogether with this, a dome is a dome whether it is built over a circular or a square base, though it has to be admitted that the method of domical buildings over a square plan led to great architectural refinements in treatment.

But if we grant that the problem was only solved when domes were constructed over square bases, the credit of the beginning seems to lie with Persia; and, although the dome is a feature of Mohamedan architecture, the dome in Persia did not begin with the Mohamedan conquest, it began in Sassanian time before that date, as instanced by various buildings of the Sassanian dynasty. In India, there were domes from early times, but they were not true domes, they were constructed with concentric rings or with slabs laid diagonally, and ingenious in their way they were not the more beautiful forms of domes in the Mogul days. The dome was first built of a much flatter section than at present and was therefore a more risky constructive problem, indeed it often failed, but from the failures, which showed defects in stability, lessons were learnt and the old engineers acquired the necessary knowledge from them. It has always been remarkable how in days when dissemination of knowledge was difficult, art progressed, and beautiful domes came to be constructed in different parts of the world. In that construction too, it is remarkable how great was the ingenuity displayed in uniting the requirements of a circular roof with a square plan. The adjustment may be crude or it may be very highly artistic, and those of us who have troubled to study the methods in India must often have admired the skill of the old artificers. There are many examples of the way in which the square melted, so to speak, into the circle, and even among the comparatively minor buildings the mosque in old Indarpat near Delhi is an instance of the beauty of a logically designed construction to meet the requirements.

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Notes and Comments.

Sarda Canal.—This project, one of the biggest irrigation undertakings in Northern India, will be opened by His Excellency Sir Alexander Muddiman some time in December next.

Unfiltered Water Supply Scheme.—The work of laying a 12-inch main along Lower Circular Road, Calcutta, for improving the pressure of unfiltered water on the east side of Tolly's Nullah has again been delayed for two weeks.

Dead Sea "Fruits."—Asked whether there had been any further developments regarding the Dead Sea salt concession, Mr. L. S. Amery, Colonial Secretary, replied that negotiations were still under examination by the Palestine and Transjordanian Governments.

Calcutta Tramways Co.—An important step towards the development of Southern Calcutta was taken on the 8th instant when the new tramway extension from Kalighat to Ballygunge Station was opened. The track is two miles in length and will provide easy communication between Calcutta and the area east of Russa Road.

Mysore State.—The length of the railway lines worked by the Madras and Southern Mahratta Company is 988 miles of broad gauge and 261 60 miles of metre gauge. The State has for the present 2,061 miles of roads of which 1,613¾ miles are metalled. The total length of district roads is 3,569 miles of which 1,754 miles are metalled.

Seaport for Mysore.—Answering an interpellation in the Mysore Assembly regarding the prospects of a seaport for Mysore, the Chief Secretary said that rough estimates have been prepared for two alternate schemes at Bhatkal costing Rs. 144 and Rs. 170 lakhs, respectively. It was also stated that the Arsul-Bhatkal railway extension costing nearly Rs. 145 lakhs was also under contemplation.

Third Class Touring Car.—The South Indian Railway has given a lead in catering for marriage and pilgrim parties. It has constructed for the special convenience of pilgrim and marriage parties a third class tourist car with accommodation for 56 persons and sleeping accommodation for 28. It is provided with a kitchen, a dining-room and separate baths and lavatories for men and women.

The Coal Trade.—The present low selling price of first class coal is being discussed by both the Indian Mining Association and the Indian Mining Federation. There has been an improvement in despatches from the Kidderpore Docks, but Bombay is still completely out of the market. Due to heavy despatches recently stocks on the Bengal and North-Western Railway are at last moving upwards.

Royal Indian Marine.—The appointment of Rear-Admiral Humphrey Walwyn to be Flag Officer Commanding and Director of the Royal Indian Marine is the first appointment of its kind since the decision to reconstruct the Royal Indian Marine as a combatant force to enable India to enter upon the first stage of naval development with a view ultimately to undertaking her own naval defence.

Aerial Survey of Forests.—A Resolution of the Bengal Government on the survey and settlement reports of the province for the year ended 30th September 1927, says that the most interesting item of survey work during the year was the survey carried out from the air of a forest area in Chittagong by the Air Survey Company. This was a new venture, but its result was tested by the Survey of India and was found to be quite satisfactory.

Colonel G. L. Colvin.—Our congratulations to this officer on his appointment as an Aide-de-camp to His Majesty. Colonel Colvin is Commandant, East Indian Railway Regiment, Auxiliary Force, India, as well as Agent, East Indian Railway. His past career is well known, having rendered signal service in various capacities especially as a railway transport officer in Europe during the war. He was awarded the C. B., the C. M. G. and D. S. O. and was five times mentioned in despatches.

Calcutta Bridges.—Rai Bahadur Ramtaran Banerji, Mr. Sanat Kumar Roy Chowdhury and the Chief Engineer were elected on the 11th instant by the Calcutta Corporation to represent them at the proposed conference between the Government, the Corporation and the Improvement Trust to consider and report in regard to the apportionment of the cost of reconstructing the bridges outlying Calcutta—other than the Hastings and the Barrackpore bridges—over the Circular Canal and Tolly's Nullah.

New Wireless Tests.—Further important developments in wireless are expected shortly. Marconi is nearing the completion of experiments for the simultaneous transmission of wireless telegraphy over the beam system. Tests are at present being made for Transatlantic transmission with an apparatus which, it is claimed, can operate two high speed telegraph circuits simultaneously with one duplex telephone system, utilising the same transmitter aerial and one wave length for all three circuits.

India Air Service.—In the House of Commons, replying on the 6th instant, with regard to the negotiations for the establishment of a civil air service between Iraq and India, Sir Samuel Hoare, the Air Minister, said that the Persian Government had expressed its readiness to negotiate with regard to the conditions under which the service was to be operated over Persian territory. A representative of the Imperial Airways had consequently proceeded to Persia. Sir Samuel Hoare said he understood that discussions on the subject were now proceeding at Teheran.

Indian Railway Conference Association.—The electrical section of this Association met at Simla on 11th June to decide some important points. The meeting is attended by the following officers:—Mr. F. T. Wright, Chief Electrical Engineer, Bombay, Baroda and Central India Railway (Chairman); Mr. D. K. Shepherd, Electrical Engineer, Bengal and North Western and Rohilkund and Kumaon Railway; Mr. A. R. Gundry, Chief Electrical Engineer, East Indian Railway; Mr. G. Rackstraw, Deputy Loco. Superintendent (Electrical), Eastern Bengal Railway; Mr. L. Barber, acting Electrical Engineer, Great Indian Peninsular Railway; Mr. A. H. Chilton, senior Electrical Engineer, North Western Railway, and Mr. C. V. Bliss, General Secretary, Railway Conference Association.

Indian Stores Department Contracts.—The following are among the contracts placed with firms in India by the Indian Stores Department during the week ending 30th May 1928:—Messrs. P. Orr and Sons, Ltd., Madras—12 Levels, reversible, 14 inches, Rs. 5,670 free delivery at Rahim Yar Khan, *ex* stock; Messrs. Jessop and Co., Ltd., Calcutta—140 cwts. Lead, pig, Burmah, refined, minimum purity 99·8 per cent., Rs. 2,310 f. o. r. Howrah; Messrs. John Fowler and Co. (India), Ltd., Bombay—1 pair Hind Roller Rims, for Fowler's Steam Road Roller, Rs. 1,400 free delivery at Bandra.

The Imperial Mail.—The question of duplicating this Mail and making booking arrangements for it in London is now under consideration by the G. I. P. and E. I. Railways. Advices received by the Railway Board from London show that foreign tourists are being attracted to India in larger numbers, so that the Indian Imperial Mail has been fully booked from 14th October next onwards right through the busy season. There are in addition long waiting lists of from 20 to 50 passengers per week registered for this train. So successful was the running of the Punjab Limited Express last year that the G. I. P. Railway will probably run a train similar to the Imperial Mail for the important Bombay-Delhi-Punjab service from October next.

Travancore Water Supply Scheme.—The large schemes of public utility, namely, electrification and water supply in Trivandrum, the capital of the State, are now being considered by the Travancore Darbar. Trivandrum has hitherto depended for its water supply entirely upon wells. This has proved precarious in the upper regions of the city and risky in the lower regions. A scheme for the supply of drinking water to the city has been under consideration for the last 30 years and five years ago the scheme was investigated. Government scrutinised the scheme and obtained expert advice. The project has now been accorded administrative sanction and detailed estimates are in preparation. According to the scheme it is proposed to cover an area of 14 square miles and to supply 4,500,000 gallons of water a day. The supply conduit will be 8 miles in length. The whole project is estimated to cost about Rs. 35 lakhs.

Calcutta Port Trust.—A paper on the Port of Calcutta was read at a meeting of the Royal Society of Arts, London, on the 8th instant, at which Sir Charles McLeod presided. Mr. S. C. Stuart-Williams, Chairman of the Port Commissioners, dealing with the financial side of development work paid a tribute to the cordial support the Administration had received from the Government of India, the Government of Bengal, the commercial community of Calcutta and the banks in London and Calcutta, which had assisted in the arrangement of finance. He hoped and sincerely believed that their confidence had not been misplaced and that it might now be reasonably expected that they had returned to the pre-war position, and that the increases in tonnage which had marked the last two years would be permanent. While the opening of the dock would mean an increased burden on the revenue account it was hoped that the burden would not exceed the heavy amount available in the margin of income, and if it should do so the substantial reserve that was available would be sufficient to meet any probable contingency.

Settlement Operations.—A Resolution of the Bengal Government on the Settlement reports of the province for the year ended 30th September 1927, says that the major settlement operations in Nadia were brought to a close and those in Khulna and Pabna-Bogra were practically finished during the year. The operations in Murshidabad-Birbhum and in the 24-Parganas were in full swing with all stages of work in progress. The former settlement has got through an unusually heavy programme with efficiency and despatch, while the latter, in spite of the exceptionally large number of plots per square mile, made satisfactory progress in almost all branches of work. The total area of which a record of rights has been prepared is now 48,366 square miles, out of 66,498 square miles in the Presidency to which the Bengal Tenancy Act applies. The settlement maps and records continued to prove of assistance to the various departments of administration which used them, and their popularity with the public was evidenced by the increased number of sales of "khatians" and village-maps during the year.

New Line Linking up N. and S. India.—The Railway Board will shortly issue orders for the construction of a line of 91 miles, which, when completed, will link the existing isolated metre-gauge systems of Northern and Southern India. The proposal has been under consideration for many years, and the survey was made in 1912, but as the result of subsequent investigations it was decided that the country through which this line was projected could best be served by branches of the G. I. P. Railway from Akola. The line which it is now proposed to construct is part of this general scheme. It practically cuts the existing G. I. P. Railway from Bhusawal to Badnera at right angles at Akola, one branch going almost directly north to Hiwarkhed and the other south to Basim. The total length is about 91 miles, and the line will be constructed as a light broad-gauge line. The line will pass through the Akot, Akola and Basim taluks of Akola district. From the financial point of view the project in the sixth year after opening is estimated to yield a return of 6·3 per cent. A sum of Rs. 14,00,000 has been provided in the Budget for expenditure on this line during the year 1928-29.

How Cars are Improving.—Mr. John Prioleau, who writes such excellent articles on the subject of motor cars in the "Evening Standard," comments on what he said after the last Motor Show. He had prophesied improvements in several directions and he appears to be convinced that his forecasts were accurate. Steering, he says, is greatly improved in practically every type of car, in fact it would be difficult to improve the steering gear even of the cheaper makes of cars. There is also better road-holding. Engine vibration has been greatly reduced in cars costing over £500. The gear-boxes are better, especially in the smaller and inexpensive cars, and brakes, as a rule, are considerably better. Mr. Prioleau says that he found one of the best brake sets fitted to a car which cost only a little over £200. Coachwork has shared in the general improvement, and the general finish of cars has reached a stage of surprising excellence. All this is very satisfactory news, Britain has always been conspicuous in the world for the high quality of her outturn in all branches of machinery, but on account of that high quality she has sometimes been expensive. At the

present time, however, in spite of all the difficulties, the high taxation due to the war, the labour troubles and the rest, it is very remarkable how she has triumphed over all disadvantages. The competition has been very severe, Continental countries have had cheaper labour, America has protection and mass production, yet the British cars, price for price, continue to be the best.

Kempe's Engineers' Year-Book for 1928.—The thirty-fifth edition of a publication which is so valuable to engineers is worth bringing to their notice. It has been revised throughout and brought to the latest date, with a review of engineering progress during the past year. It is a most useful compendium of the modern practice of civil, mechanical, electrical, marine, gas, aero, mine, and metallurgical engineering, containing over 3,000 pages, 2,500 illustrations, and published at the price of 30*s*., it is a work of reference which engineers in this country will like to have by them, inasmuch as it brings together all the technical information which an engineer may at any time require in his daily work. In the edition for 1928, particular attention has been devoted to the important sections relating to steam power, electrical engineering, electric traction, internal combustion engines, automobiles, refrigeration, and highway engineering, in which branches of the profession there have been developments. In highway engineering alone, as is well known, the roads' engineer has every need to keep himself abreast of modern methods. But that is only one section, and there are many other branches of work in which engineers need to keep themselves up to date.

Mill Areas Sewerage Schemes.—Of the two big sewerage schemes, one at Titagarh and the other at Kankinara, two important jute mill areas in Bengal, the former is likely to be completed in course of the next three months and the system is expected to come into operation in the coming cold weather, while the latter, which has been modified, is awaiting the sanction of the Government of Bengal. The projects are estimated to cost about Rs. 12 and 14 lakhs, respectively, and they are designed to serve about one million of people in two of the most congested districts in the mill area. The sewerage at Titagarh came into operation in July 1927 but was not wholly successful and it was decided to adopt the "Simplex" purification system on the activated sludge process. Work in this connection commenced recently, the additional cost being estimated at about Rs. 95,000. The Commissioners of the Bhatpara Municipality have reconsidered their project, and have asked the Engineering Department to modify it. It has now been proposed to instal the activated sludge purification plant, which will mean no increase in the cost of initial expense, but an increase in the maintenance cost of between Rs. 4,000 and Rs. 5,000 per annum.

A British "Six" for Overseas.—Judging by the rapidly increasing membership of the leading motoring organisations, the ranks of British motorists will be considerably augmented during the coming season. Reports from the old-established manufacturers are satisfactory, and in some cases refer to very considerable progress. The makers of the Talbot car, for instance, are experiencing a big increase in business and look forward to the biggest output since the inception of the famous Clement Talbot Company. They are, of course, concentrating on one particular model, the 14-45 h.-p. 6-cylinder, which has, by reason of its special suitability, already gained an enviable reputation overseas. Special attention has been paid to the question of cooling and springing and, as a result, this model is undoubtedly fitted for service in any country. Thus, quite recently, a purchaser in Southern India took delivery of a brand new "Fourteen-Forty-five" and proceeded to drive it home. The last 16 miles of the journey was over the Ghaut where the road climbs from an elevation of 400 feet above sea-level to a height of over 3,800 feet, while, in addition, it is never straight for more than about 100 yards at a time. The new car, however, pulled beautifully throughout and the water showed no signs of boiling. A very satisfied owner in Malay, who, incidentally, is himself an engineer, has done 11,000 miles with his Talbot and has been stopped but once, for a broken contact breaker spring. In that distance he has not had a single puncture and his petrol consumption has averaged about 20 m. p. g. and oil about 1,500 m. p. g.

Motor Boat Racing.—Interest in motoring is infectious, and for those who would experience new thrills there is nothing to beat the sporting side of motor boating. Class racing, that is racing between boats of the same design and having the same type of engine, probably affords the keenest sport. Every competitor has equal chances so far as the boat is concerned, and it is therefore the skill of the skipper that brings success. With this idea in view the Ailsa Craig Motor Co., Ltd., of Chiswick, London, have designed a new 20-feet boat of the Fast Runabout type. Equipped with the latest 3-bearing crankshaft model of their famous 10-16 h.-p. Ailsa Craig Kid engine, it is capable of a speed of as much as 16 knots. Its appearance is very smart, the hull being of Vee bottom design with a sporting reverse sheer. Accommodation is provided for four persons including the driver, and the spacing of the seat allows full leg room. The running costs are attractively low, for the Kid engine uses less than a gallon of petrol an hour, while the oil works out to a fraction of a penny for the same period. The equipment is very complete and includes a neat set of electric lamps for port, starboard and head lights, cushioned seats, etc. Apart from the sporting possibilities of such a boat, there is its utilitarian side as a fast yacht's tender. Being light and easy to handle in davits, it is a speedy means of communication between ship and shore, while the possibilities of pleasure runs up rivers and creeks is doubly alluring. Priced at the moderate figure of £230, with everything on ready to drive away, and as easy to run as any car, it is a handy class of boat that should appeal to the motorist, who would enjoy the thrill of speed without encountering the inconvenience of congested roads.

The Rise of a Huge Industry.—In view of the present tremendous employment of asbestos-cement building materials it is interesting to look back at the more recent history of such products as Poilite, which are now world-renowned. First attempts at the manufacture of asbestos roofing tiles were confronted with innumerable difficulties, and it was not until 1913 that real results were achieved and an output of some 6,000 tons a year reached. Such a total in the light of requirements to-day seems hopelessly small, but it was a beginning. After the War there were four plants in England making asbestos-cement building

materials. Bell's amalgamated with one of these in 1922, and shortly after began to improve the results. Now, in 1928, a further amalgamation takes place, with the British Fibrocement Works, Ltd., who have, perhaps, the largest output of asbestos-cement in England, outside Bell's. Thus the amalgamation will control more than three-quarters of the British production, and its combined resources will undoubtedly make for greater efficiency. With three well-equipped factories in various parts of England Bell's will be in an exceedingly strong position to withstand competition, and in an even better position to effect quick and economical delivery from local stocks. The development of this trade has been achieved only by huge bulk production, and consequent reduction in costs. The combined output of the three plants to-day is well over 100,000 tons per annum, while the goods are sold at pre-war prices despite the doubled costs of raw materials, asbestos and Portland cement. The scope of Poilite and Fibrocement is not limited to the activity of house building in Britain, for the company has a very large and growing export trade, while new products are continually being marketed, as, for instance, the new decorative materials and asbestos-cement pipes for a variety of purposes.

Steam Rail Car Developments.—The keen competition between road and rail transport—a subject that is receiving particular attention in England—is no doubt mainly responsible for the rapid development of the steam rail coach. These coaches have proved of very definite value to railway companies in many parts of the world for combating the growing road competition, and have been found particularly useful in sparsely populated districts overseas, as well as operating on "branch lines," and thus acting as feeders to the main lines. Much interest is being shown by railway engineers in the latest developments of the well-known "Sentinel-Cammell" steam rail car. Here the engine, which embodies all the main features of the former design, has been arranged to give increased power at even lower steam consumption; while that all important question of accessibility has received particular attention. The six single-acting cylinders practically eliminate vibration, and wear has been reduced to a minimum by the ample bearing areas. The riding is now equal to first-class main line stock, and this has been made possible by the new drive which is now by flexible cardan shaft through bevel and spur gearing on the leading bogie. The body is constructed on the usual "Sentinel-Cammell" lines, but is now one continuous structure, and is carried on two bogies of standard railway design. Owing to the absence of articulation the controls are much simplified; for since the boiler and engine are in the main frame there are no flexible steam or exhaust pipes, and the controls run in a straight line from end to end. The boiler which retains all the valuable features of the earlier type as regards accessibility and circulation, is designed to give 2,350 lb. of steam as against 1,800 lb. in the boiler previously used. The steam space has been increased, thus increasing its efficiency, and preventing troubles due to priming; while the lagging has been increased and a number of improvements made to the mountings. Meantime it is interesting to note that, owing to the simplified construction and also to the fact that the output of these cars has appreciably increased, considerable reductions in price have been effected.

Current News.

MR. H. T. BAYLIS is appointed to officiate as Traffic Manager, Eastern Bengal Railway.

MR. A. T. STOWELL, Chief Operating Superintendent, N. W. Railway, has been permitted to retire.

MAJOR R. E. GORDON, Executive Engineer, reverts to the N. W. Railway on completion of special duty with the Railway Board.

THE new bridge across the Tweed at Berwick, symbolical of the union between England and Scotland, was inaugurated by the Prince of Wales.

THE services of Mr. H. F. Knight, Secretary, Road Development Committee, have been replaced at the disposal of the Government of Bombay.

THE Railway Board has sanctioned the construction of a metre gauge line of 17 miles between Shaistaganj and Balla, by the Assam-Bengal Railway.

MISS L. I. LLOYD has been appointed as the Calcutta Corporation delegate to the Royal Sanitary Institute to be held at Plymouth from 16th to 21st July 1928.

NELSON (British Columbia) has awarded a contract for the third 3,000 h.-p. unit in the municipal power plant to the Canadian General Electric Company at $230,000.

THE Railway Board have sanctioned the construction by the G. I. P. Railway of a line, on the 5 feet 6-inch gauge, from Amraoti to Narjhed, a distance of about 79 miles.

THE Railway Board have sanctioned the construction of a line of railway 45 miles, on the 5 feet 6-inch gauge, from Belapur to Sheogan, by the G. I. P. Railway administration.

IT is understood that a special session of the International Telegraph Conference will be held in Brussels about 10th September, to consider the question of code language and its tariff.

THE King has approved of the appointment of Honorary Colonel G. L. Colvin, Commandant, East Indian Railway Regiment, Auxiliary Force, India, as an Aide-de-camp to His Majesty.

THE first world's grain congress is scheduled to take place at Regina, Saskatchewan, in 1932, which year will mark the 50th anniversary of the arrival of the Canadian Pacific Railway in the West.

SIR JAMES SIMPSON, of Messrs. Gordon Woodroffe and Co., of Madras, will succeed Sir Walter Wilson as the representative of the Associated Chambers of Commerce in the Legislative Assembly at the coming session.

THE Australian Government has ordered thirty-four Moth aeroplanes for the Air Force. Twenty are to be constructed in Great Britain, and the remainder, except for their engines, are to be built in the Commonwealth.

A COMPANY has been formed in Winnipeg for prospecting for minerals in Northern Canada from the air. It has ordered five large aeroplanes capable of carrying six passengers over a maximum radius of 2,000 miles and three smaller machines for 500-mile cruises.

ENGINEER LIEUTENANT-COMMANDER A. E. F. ORCHARD is appointed to officiate as Assistant to the Principal Engineer and Ship Surveyor and Superintending Engineer to the Burma Government, *vice* Engineer Lieutenant A. E. Wooley, Royal Indian Marine, vacated.

WITH a view to ending the water shortage at Nagpur the Standing Committee of the Nagpur Municipal Committee has, it is understood, recommended the general body to approach the local Government for a loan of rupees two lakhs for the purpose of improving the supply.

A SERVICE of aeroplanes has been organised by the Canadian Pacific Express Company for expediting the delivery of overseas mails by taking them off the incoming steamers at Rimouski, near the mouth of the St. Lawrence, and flying to Quebec, Montreal, Ottawa and Toronto.

AGREEMENTS have been reached between Arcos, Ltd., and a number of British firms for the placing of large orders for equipment for textile factories, electric power stations, and other industrial enterprises. The sum involved, including orders for machinery recently placed, exceeds £4,000,000.

FROM the next spring the Peninsular and Oriental sailings homeward will provide greater convenience to the passengers inasmuch as there will be no transhipment at Aden. All the steamers will proceed through to Marseilles and London. The last voyage requiring transhipment will be by the "Razmak" on 23rd June.

THE new steamer, the "Worthing," for the Newhaven-Dieppe service, was launched by William Denny and Brothers, Ltd., of Dumbarton, on 3rd May. She will be the first oil-burning vessel in that service, will have a speed of 24 knots and have accommodation for 1,500 passengers. The service is jointly owned by the Southern Railway Company and the French State Railways.

Foreign Notes.

New Manchurian Railway Project.—The first new railway to be taken up by the Chinese Eastern Railway to attract North Manchurian produce is the Anda-Paichuan line, starting at Anda, one of the leading produce markets on the Western section. The distance is 187 miles. The agricultural and mineral produce such as beans, beancakes, oil, kaoling, maize and coal, etc., accumulating at Paichuan is put at 500,000 tons a year. The Chinese Eastern Railway Directorate is reported to be prepared to furnish funds and building materials for the construction of the line.

Salt River Power Station.—The new power station erected by the Electricity Supply Commission to supply power for the running of the passenger trains on the suburban lines between Cape Town and Simonstown has been put into commission. Situated a couple of miles from Cape Town this 30,000-kw. station is linked up with the municipal power station of about the same capacity, so that at any time the one can assist the other. The electrification of the suburban lines will not be completed until July, by which time the two big 6 feet pipe lines which are being run out to sea for a distance of 1,200 feet will have been completed, so that salt circulation water can be supplied to the condensers at the power station.

British Roadmaking in Baghdad.—It is pleasing to hear that, due largely to the ability and efficiency of Mr. E. T. Caparn, Municipal Engineer of Baghdad, the reconstruction of New Street, the principal thoroughfare in the city, has been successfully carried out. New Street, which is about two miles long, was treated at intervals to surfacings of gravel, which worked down into the mud. On the top of the gravel-mud was laid a British reinforced concrete fabric, and in this was poured 4 inches of concrete with a top dressing of bitumen, and the result is described as being very satisfactory. Another triumph for British engineering skill and the excellence of British materials, says "Municipal Engineering and Sanitary Record and the Municipal Motor."

Arc-welded Motor-cars.—The increasing use of welding in automobile manufacture is demonstrated by the fact that a large number of parts on the new Ford car are constructed by arc welding. These parts include the rear axle housing, the steering gear casing, the radius rod, the spare-tire carrier, the drag link for the front axle and the axle rods. It is said that experments are now under way preparatory to welding several other parts in addition to those mentioned. In the past few months the Ford Company has installed approximately 30 automatic arc-welding equipments for this work, manufactured by the General Electric Company of America. Although this is considered a fair-sized automatic welding installation, it is but the beginning of the automatic arc-welding operations planned by the automobile company.

The South-East England Electricity Scheme.—Specifications for the main overhead transmission lines for the London and South-East England Electricity Scheme are about to be issued by the Central Electricity Board, and those for the transforming stations and switchgear will follow in due course, says the "Engineer." The project, which will involve an expenditure of £12,000,000, is designed to supply electricity for power and lighting to a population of 11,000,000 people, living in an area of 8,828 square miles, with boundaries at Peterborough in the north, Alyesbury, Reading and Basingstoke in the west, Worthing, Brighton, Eastbourne, Hastings and Folkestone in the south, and Ipswich, Colchester, Southend and Ramsgate in the east. Five hundred and eleven miles of transmission lines will be employed as against 225 miles for the Central Scotland scheme. An indication of the magnitude of the contracts about to be placed can be gathered from the fact that in the latter case tenders accepted in February represented nearly £300,000. Lattice towers made of galvanised steel and conforming to the design settled in consultation with Sir Reginald Blomfield will carry the line. The towers will be approximately 80 feet high and 16 feet square at the base, and will be spaced about 300 yards apart. It is expected that the next electricity scheme to be issued will relate to Lancashire and North Wales.

Electricity in Agriculture in France.—According to the "Implement and Machinery Review," the distribution of electrical energy to farms in mountainous districts has become almost general in France, and at a recent conference at Grenoble it was stated that practically all the communes in the department of the Isère were electrified. The farms are more or less isolated, and as there is little scope for co-operation each farmer must have a complete equipment of machinery, even to small thrashing machines, special types of which are constructed for use in the mountains. In such cases the employment of electrical energy has become indispensable. During the thrashing season the demands for power so far exceed the capacity of the transformers that the distributing companies are obliged to insert clauses in the contracts whereby users can only take a surplus supply in rotation, which means that each farmer is usually allowed two days a week for his thrashing. Electrically operated milking machines are being employed on an increasingly large scale, but nothing has been done in the Department of the Isère with electric ploughing on account of the smallness of the farms. Manufacturers of electric ploughing tackle are demonstrating the value of their plants with so much success that a number of them are now employed in the beetfields and on farms in the northern departments, where there is a particularly complete system of electrical distribution, and the results are declared to be quite satisfactory. The plants are generally owned by co-operative societies.

Detecting Transverse Fissures in Rails.—We have, says the "Railway Gazette," on more than one occasion referred to investigations of transverse fissures in rails, and at the recent convention of the American Railway Engineering Association a special report was devoted to the subject, which has assumed considerable importance in America. It was then reported that a car had been designed and built which, in travelling over the track, would detect these fissures, mark them on a chart, and also spot the rails with paint to indicate the position of the defects. An illustrated description of this car is now given in our American contemporary, "Engineering News-Record." The car has been built by the Sperry Development Company in agreement with the A. R. E. A., and the method employed consists in forcing a high current at low voltage through the rail and, by continuously moving a set of conductors along the rail-length, energise the entire rail. The resistance effect of discontinuities in the head could be detected by a pair of brushes, which would pick up this minute potential difference and transmit it to radio-amplifying holes to increase the impulse sufficiently to deflect the needle in a galvanometer or to actuate pens through relays for a permanent paper record. The apparatus and necessary power plant are mounted on a track-maintenance car drawn by a motor at approximately 10 m. p. h. Each contact consists of eight copper brushes pressed against the rail-head by springs. A relay controls the release of a spray of paint against the side of a rail at the same time that the defect is recorded on the chart. The apparatus has proved successful, and internal breaks only 2 per cent. of the head area have been discovered and recorded.

Locomotives and Non-Stop Runs.—According to the "Railway Gazette," the successful achievement of the London and North Eastern and London Midland and Scottish Railways in making non-stop runs between London, Edinburgh and Glasgow has demonstrated in a public manner what was already well understood by locomotive and traffic department officers, namely, that locomotives as designed and built to-day can be relied upon to cover any reasonable distance without fear of mechanical breakdown Indeed, the matter resolves itself into one of coal and water supplies, and provided that a clear road is secured there is very little in it beyond that. The question of manning the engines—at one time thought to be an almost insuperable difficulty—has been disposed of in an ingenious fashion by the London and North Eastern Railway, whose corridor tenders provide a ready and convenient means of access between the train and the footplate. These tenders, with their full capacity of 9 tons, make provision for even a longer run than from London to Edinburgh, and provide a reserve sufficient to meet almost any condition of weather or other contingency. In the case of water replenishment, there is always the anxiety that the level in the troughs may have been reduced by the recent passage of another train in front, or that for some reason difficulty might be experienced in manipulating the scoop, and it would indeed be a regrettable thing if, when everything else was running splendidly, a special stop had to be made for water. It is not to be anticipated that anything of the sort will occur, although north of Newcastle the facilities for taking up water are not so complete as is the case between London and that point.

New Electric Locomotives.—Two electric locomotives of a new type, which are designed to operate from either a trolley-wire or a storage-battery supply, have been put in service by the Chicago, North Shore and Milwaukee Railroad. Provision is made for the automatic charging of the battery when necessary from the trolley supply. The flexibility of operation enables these locomotives to switch cars into industrial yards, etc., equipped with tracks, but not trolley connections. The locomotives were built by the General Electric Company of America. The equipment on each includes four 200 h.-p. motors and a 192-cell storage battery capable of delivering 260 kwh. on one charge. Operating on the storage battery, one of these locomotives can haul a 1,000-ton train at a speed of from 10 to 12 miles per hour on a tangent level track, or, running light, it will attain a maximum speed of from 30 to 35 miles per hour. A 25-kw. motor-generator set is located in the main cab of each locomotive. Its control is automatic by the use of a contact in an ampere-hour meter in the battery circuit. When the battery becomes fully charged this contact automatically causes the motor-generator set to shut-down; when the battery becomes about 15 per cent. discharged again, the set is automatically started. If while the motor generator set is running the locomotive leaves the electrified line, the set will shut down and start again upon the return of trolley power, without attention from the operator. Transfer from the trolley to battery power is effected automatically by means of a relay which actuates the transfer contactors. In order to restore the trolley power, however, it is necessary to move the master controller to the first notch. Each locomotive has a one-hour rating in tractive effort of 22,000 lb. at 14 miles per hour, and a continuous rating of 17,000 lb. at 15 miles per hour, when operating from a 600-volt trolley-wire supply.

The New Nelson Liners.—On 3rd May there was launched from the East Yard of Harland and Wolff, Ltd., Belfast, the 14,450 gross ton motor passenger and cargo liner "Highland Monarch," which is the first of five similar vessels ordered for the service of H. and W. Nelson, Ltd., between Great Britain, Spain and Portugal and South America. The new liner has a length between perpendiculars of 520 feet, with a breadth of 69 feet and a depth to the upper deck of 35 feet 9 inches. Her propelling machinery comprises two sets of eight-cylinder Harland-B. and W. double-acting four-cycle engines. Each engine will drive its own air injection compressors, and the main cylinders will be cooled by fresh water, while the pistons will be oil cooled. An exhaust gas boiler, which may also be separately oil fired, will be installed to work in conjunction with either one or both of the main engines. Electricity will be widely used throughout the ship, and the auxiliary generator equipment will include four 200-kw. sets, driven by Harland-B. and W. trunk type engines. As five of the cargo holds and most of the 'tween deck spaces are to be insulated and arranged for the carriage of chilled meat, considerable refrigerating plant will be required. The main refrigerating machinery is of especial interest, as it will be, it is understood, the first of its kind to be driven by horizontal oil engines. There will be two duplex double acting anhydrous ammonia compressors, with a bore of 11½ inches and a stroke of 15 inches, each connected to a four-cylinder *vis-à-vis* Premier oil engine. The designed output of the engine is 240 b. h.-p., and the normal working speed will bea bout 90 r. p. m., but speeds up to 180 r. p. m. may be used if desired. The appearance of the new Nelson liners will resemble that of other new large motor liners with their two low funnels and a cruiser stern. Accommodation will be arranged for 135 first-class and 66 intermediate-class passengers, as well as for a number of emigrants.

General Articles.

LARGE STEAM WINDING ENGINES.

THE pair of engines illustrated on the opposite page is one of two sets which Markham and Co., Ltd., of Chesterfield, are building for the Randfontein Estates and Gold Mining Company, Witwatersrand, South Africa, and for the New State Areas, Ltd. These engines, according to the "Engineer," are to serve as man hoists for vertical shafts, about 5,000 feet deep, for static loads up to 58,500 lb. on one drum unbalanced and 46,000 lb. when balanced, *i. e.*, with the clutches engaged. The steam cylinders are each 40 inches in diameter by 72 inches stroke, designed for a working pressure of 160 lb. per square inch, and they are steam jacketed, lagged and finished off with planished steel. Drop valves are fitted on the admission side and Corliss gear on the exhaust, the drop valves being controlled by a governor which operates on the cams of the trip gear in the customary manner, so as to allow of a very late cut-off at starting and during the period of acceleration combined with economical running when the maximum rope speed of 50 feet per second is attained. The reversing gear is of the Gooch link-motion type with excentrics placed between the main bearing and the drum. Reversing is effected by a separate engine.

The pistons of the main cylinders are of box section with Lockwood and Carlisle rings, and junk cover which enable the rings to be removed without taking the pistons out of the cylinders. The piston-rods are cottered into crossheads, and carry the pistons on cones secured by nuts, while the tail rods are each provided with a slide and block. Metallic packings are used in each case. The cranks are of cast steel and of the counter-balanced disc type, 8 feet 2 inches diameter, and are shrunk on the shaft and securely keyed. The crankshaft, which is 24 inches diameter through the drums, is of open-hearth steel, turned and finished all over and bored with a 4-inch hole throughout its entire length. The clutch seats on the shaft are of square section with round corners. The bed-plate is of the mammoth pattern with the seating for the main bearing cast as an integral part with a hooded target end, which is bored and faced to receive the guide section. Lubrication of the main and centre bearings of the shaft is effected by means of a gravity oil tank and a return pump.

The reversing engine is of the horizontal pattern with a cataract cylinder, and the usual floating gear, and is connected to the links through the medium of a weigh shaft, levers and rods. The engine has a 7-inch by 12-inch cylinder.

The rope drums have cast steel sides made in halves with turned rims on the outside, to which the barrel plates are bolted. The outside of each drum has an annular machined facing and a projected spigot, on which is bolted the brake rim also in halves, while concentric with this rim is a reversed spigot to carry the clutch ring which is bolted in place. Each drum is 14 feet diameter by 5 feet 6 inches wide, and is intended to hold 5,000 feet of rope in four layers. The drums have parallel shallow grooves 2¹/16 inches pitch to suit 2-inch ropes. Each drum has a cast steel clutch gearing with the clutch ring alluded to above. The clutches are arranged to slide on the square formed on the crankshaft, and are operated by hand through a wheel and screw gear on the driver's platform. Each drum is fitted with a set of post brakes lined with wooden blocks. The brakes are of the calliper type operated at the top and bottom. The brake engines are fitted with dashpots and floating gear control on the steam cylinder, and are applied by deadweights, which are raised by steam pressure. In order to prevent the brakes being applied too suddenly, a spring device is provided between the weights and the main brake engine lever.

To enable the driver on the platform to see when the clutches are engaged large mirrors, mounted on an adjustable stand, are provided. In order to render it impossible for the driver to release the clutch until after the brake has been applied and *vice versâ*, an interlocking device between each clutch gear and its corresponding brake is furnished.

Each drum has its own depth indicator with a dial 10 feet diameter and a warning gong. A Whitmore "overwind" preventive device prevents starting the engines in the wrong direction and overwinding through failing to stop when desired. It also prevents excessive rope speed. Steam on its way to the cylinders passes through a separator, a screw-down stop valve and a hand-operated throttle valve in the order mentioned. The throttle valve is operated by a toggle lever so arranged that it gives a positive lock when closed, and in opening makes it possible to raise the valve so gradually that the pilot valve can be dispensed with. The toggle also enables the throttle to be opened with great ease.

All the necessary control levers and hand-wheels are grouped in a convenient manner upon a platform placed between the cylinders and raised about 6 feet 6 inches above the floor level.

The leading dimensions of the engines are as follows:—

	Feet.	Inches.
Diameter of cylinders	0	40
Stroke of cylinders	0	72
Diameter of shaft through drums ...	0	24
Diameter of main bearings	0	21
Length of main bearings	0	32
Diameter of centre bearing	0	22
Length	0	32
Diameter of crankpin	0	13
Length of crankpin	0	12
Diameter of drums	14	0
Width of drums	5	6
Diameter of crosshead pin	0	11
Length of crosshead pin	0	12

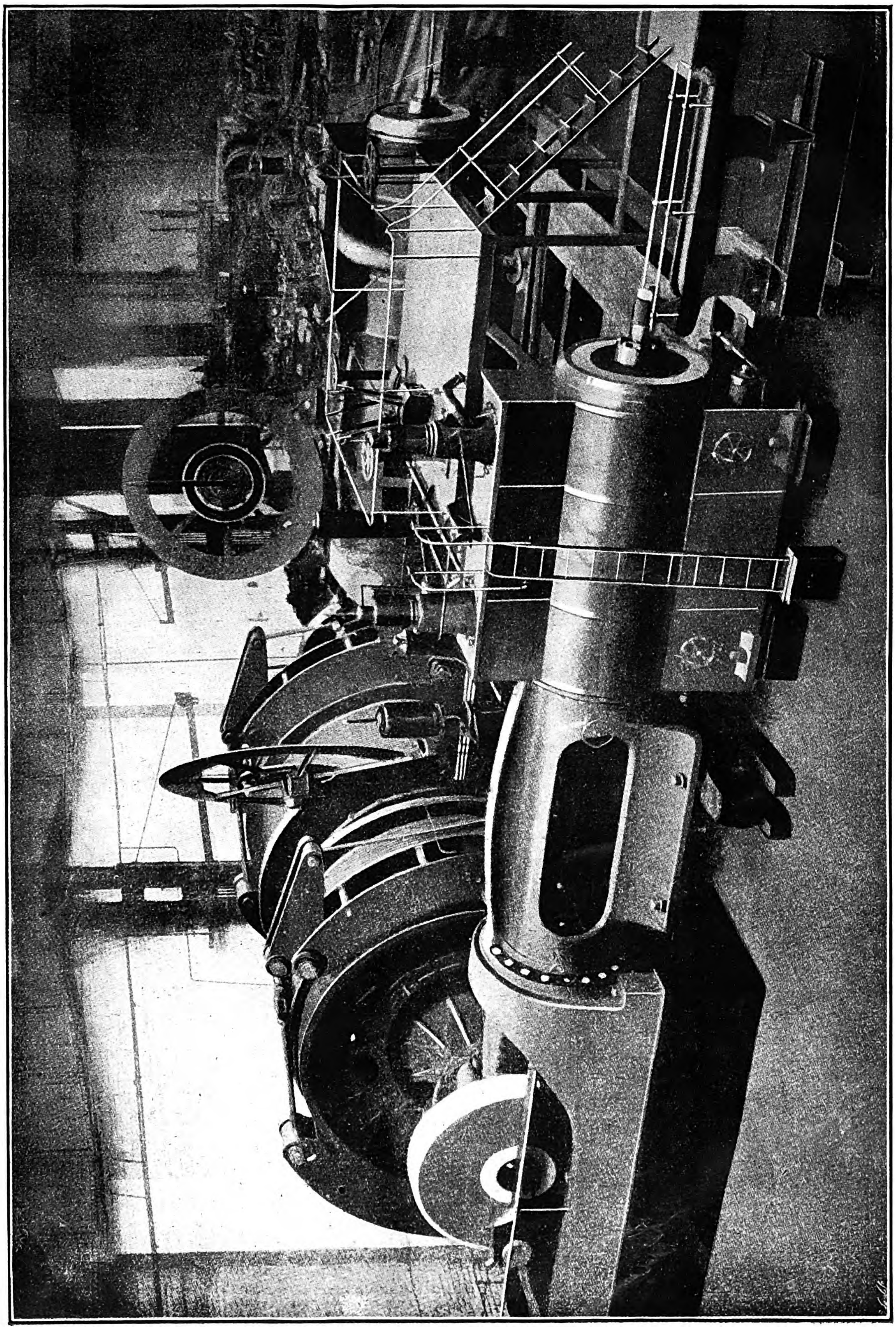
MATHEMATICS FROM A CONSULTING ENGINEER'S VIEWPOINT.

BY DR. J. A. L. WADDELL, Consulting Engineer, New York, N. Y., U. S. A.

IT was with true pleasure and satisfaction that I received a few months ago from the Real Academia de Ciencias y Artes de Barcelona a notification to the effect that I had been selected to represent that learned body at this meeting of eminent mathematicians assembled from all over the world. There are two good reasons for my satisfaction—first, the high honour conferred upon me by the selection, and second, the opportunity of visiting my native land under such favourable auspices and of meeting some of my friends of the long ago,—friends who used to be so numerous, but who now, alas! are so few.

It is more than forty years since I left Canada to practise my profession in the United States and other countries; but it has been my good fortune on several occasions to be called to the land of my birth on important engineering work. These calls were always a source of deep gratification to me, for they showed that my efforts in the engineering profession were being appreciated by my former countrymen; and they enabled me to form new friendships and renew old ones among Canadians of prominence.

One of the most profound satisfactions of a consulting engineer's life (and these are by no means few in number) is the opportunity it offers to become acquainted with the world's great men and its leaders in both intellectual and material progress.



LARGE STEAM WINDING ENGINES.

The Spanish Academy, I fear, may have made a mistake in selecting me to represent it at a mathematical congress, in that I can no longer claim to be a mathematician, if, indeed, I ever had any right to such a distinguished appellation. It is true, though, that for two years at Rensselaer and four years at the Imperial University of Japan I did teach, among other branches of Civil Engineering, the subjects of Rational and Technical Mechanics; and that to do this work properly demanded a thorough knowledge of all those branches of pure mathematics that used to be given in the leading engineering schools of America. Moreover, after graduation I delved somewhat into the subject of quaternions, hoping to find that its peculiar principles could be applied to practical engineering problems. My hope did not materialize, and, as far as I know, the beautiful methods of that fascinating study have never been utilized in engineering practice. It is possible that I am wrong about this, for my work in the specialties of bridges and railroading has led me away from the paths of the mathematician. It is true that in ordinary engineering work one uses constantly arithmetic, plane trigonometry, and a little algebra, with occasionally logarithms and conic sections, but it is not often that there is a demand for spherical trigonometry or the calculus.

The higher an engineer advances in his profession the less use does he personally make of mathematics, most of the figuring in his practice being done by his assistants. Under these conditions it is surprising to what an extent such an engineer will lose his knowledge of mathematics; for even a freshman examination in algebra would surely floor him! Once in a long time I find it necessary to use logarithms in my personal computations; and, before applying them, I have to do some studying, in order to insure that I shall make no error in their application.

The working data for my office, which are now so complete as to enable me to make in a single day an estimate of cost, correct to within two or three per cent., for a big and important bridge that in the long ago would have required all of a month's labour to figure, were, of course, established by the employment of several lines of mathematics—arithmetic, algebra, geometry, logarithms, conic sections, calculus, and mechanics; but after these data were computed and put into shape for use, the mathematics by which they were derived were no longer needed to anything like the extent they were formerly. To illustrate the character of such data, I might refer you to the numerous diagrams giving quantities of materials in bridges, as presented in my large treatise on "Bridge Engineering" and to somewhat similar diagrams in its sequel, "Economics of Bridgework." To appreciate the value and usefulness of such diagrams, it is necessary to employ them in preparing estimates of quantities of materials and cost for proposed bridges of great size or unusual type of construction.

There is a rule of practice by which I have been governed for fully half a century—ever since my student days at Rensselaer—and that is never to use in my work any purely-rational formula without first checking its correctness myself. Of course, in empirical formulæ, or in formulæ that are semi-rational—semi-empirical (of which type, by the way, I have been guilty of perpetrating many examples and of foisting them upon the engineering profession), it is necessary for one to accept them on faith as being sufficiently correct for the purpose in view; but even here it is advisable for the designer or builder to learn, as nearly as may be, how they were established, and assure himself that there is nothing fundamentally incorrect in their make-up.

Candidly speaking, I believe it is neither politic nor right for an engineer to permit himself to lose his knowledge or command of pure mathematics; for he ought to be able to afford the time to review both these and rational mechanics once every few years. American consulting engineers, however, are invariably so busy, and generally labour so many hours per day from one year's end to the next, that it would seem to them almost like stealing to take a large amount of time from their professional work for such a purpose. Many of them feel that the reading of the daily newspapers, or even giving more than a cursory glance through the technical periodicals, involves a sacrifice of valuable time.

For the first ten years of my professional career I did manage once in a while to review my mathematics, both pure and applied, but a rapidly increasing practice eventually put a stop to my so doing. If I were to live my life over, knowing what I do to-day, I believe I would make a practice of invariably devoting a certain fixed portion of my working hours to the reviewing of the pure mathematics and the mechanics I had learned at college; but I do not believe I would endeavour to carry my mathematical studies any further, because, in my opinion, the amount thereof now taught in our best technical schools is sufficient for almost all practising engineers. On the other hand, I would not omit any of the mathematical subjects that are regularly given in such schools. However, I should like to see them taught differently.

If, in any individual case, it should appear that the mathematical instruction obtained at his technical school is insufficient for an engineer's special work, he could either take a postgraduate course in advanced mathematics or else lay out and pursue a course of study therein by himself.

In respect to the methods employed in the teaching of mathematics, I have a drastic and fundamental criticism to make, yet I offer it in fear and trembling, because it is such a long time since I gave up direct connection with technical instruction—thirty-eight years, in fact,—and in that time conditions may have changed. However, during those four decades I have lectured in a great many of the technical schools of the United States and Canada; and, when so doing, I have looked more or less closely into their curricula—not particularly, however, in relation to instruction in mathematics. Nothing that I have seen in them has in any way caused me to change my mind.

The criticism I desire to submit is as follows:—

The various branches of pure mathematics that engineering students learn are too often taught them either by young instructors who are merely hirelings, earning a living for a short time by teaching, or by enthusiastic mathematicians who are men of one idea —who appear to think that in this world nothing is as important as the subject they teach and adore. They do not show the engineering students how mathematics can be usefully applied to engineering practice, for the simple reason that they themselves do not know it —nor would they be likely to explain it, even if they could, because the hireling instructor does not care to exert himself any more than is strictly necessary for the fulfilment of his daily task, and because the mathematical enthusiast usually looks with disdain upon everything utilitarian.

No; mathematics should be taught to engineering students by practical engineers, who have often had occasion in their experience to apply pure mathematics to actual engineering problems, and who have learned in so doing the true *raison d'être* of the theoretical science. Only a small percentage of engineers (or, for that matter, of educated men in any profession or calling) are capable of teaching properly any subject at all; and of these only a very few are expert in mathematics. It is, consequently, difficult to find, in a sufficient number, the right kind of mathematical instructors for the engineering schools. There are probably in the engineering profession enough of such men to fill all the positions; but the first difficulty would be to discover them, and the second to offer them sufficient pecuniary inducement to warrant them in leaving their accustomed occupation and undertaking the *rôle* of instructor.

It is a notorious fact that all technical teachers truly worthy of the name are underpaid, and that all the rest are overpaid, even if their salaries be nothing a year; because an incompetent, careless, or indifferent instructor does an incalculable amount of harm to young men who, under his teaching, are preparing themselves for their life's work. They need to have their enthusiasm for study roused to the highest pitch and kept there, in order to induce them to utilize their energies to the utmost in the acquisition of useful knowledge.

It appears to be the general opinion of both teachers and laymen that the prime function of mathematics is to provide severe mental training and to force the student to think. This may be true for students in most of the departments, such as those of law, literature, theology, or medicine; but it is not so in the various lines of technics, because in these there is given in other subjects than mathematics all the mental training that the students could possibly need —in fact, from start to finish, engineering education provides in a most drastic manner mental training galore.

For engineering students and practical engineers mathematics is neither a goddess to fall down before and worship nor merely a beautiful creation to admire, but is simply a valuable tool to employ in one's designs and constructions. In a way, a thorough knowledge of it is not as important to a consulting engineer (or to any other technical man occupying a high position in the business world) as is an absolute command of the language of the country in which he operates. One can readily hire men to make computations, but it is not feasible to find anyone able to express for another man clearly, concisely, and convincingly, in either writing or speech, the ideas it is necessary to convey to clients and to the public concerning the projects one desires to develop and the proper method to adopt for their materialization.

The preceding non-scientific remarks may appear to some of you incongruous for presentation to such a body of illustrious and learned men as are the delegates from all over the world to this International Mathematical Congress; but I hope that the practical and utilitarian character of my dicta will make them of sufficient value to cause the members of the Royal Academy of Sciences and Arts of Barcelona to conclude that they did not commit a very serious error in sending me here as their representative.

SCIENTIFIC METHODS FOR SMALL BOILER PLANT.

AN EXAMPLE OF WHAT CAN BE ACCOMPLISHED WITH WOOD FUEL.

THE remarkable developments in steam boiler plant technique during the past few years as regards water tube boilers and large installations are of great interest for the small and medium-sized industrial boiler plant, with of course suitable modifications to suit the circumstances. Particularly is this the case as regards sawdust and general wood and vegetable refuse, including bagasse (sugar cane), nut shells, and residues from extractions of dyes, alkaloids, tannins and similar products.

Typical of what can be accomplished are two recent examples of "Turbine" furnace installations in Great Britain, the first of which relates to the establishment of Messrs. W. Beint and Sons, Timber Merchants and Saw Millers of Studley Calne in Wiltshire, who have one "locomotive" type boiler. This, however, was unable to burn much of the sawdust, shavings and other material, so that large pieces of wood had to be used, such as ends of billets mixed with coal. When the forced draught was installed, however, it was found that the whole of the sawdust could be used without difficulty because of the forced draught, thus allowing the wood pieces to be sold at a good figure. In fact a characteristic example of the possibilities in this field of fuel technology is that most saw mills and other wood working establishments throughout the world are not able to utilise fully the sawdust and other small refuse for steam generation, but have to burn large pieces of wood, or even—as in the particular circumstances mentioned—purchase coal from outside. Incidentally also the carbonisation of sawdust still remains in general an unsolved problem from the commercial point of view, although many determined attempts have been made to solve it, especially using long horizontal rotary cylindrical retorts, like a small cement kiln, with either external or internal heating.

THE CHEMICAL PROPERTIES OF CRYSTALS.*

BY PROFESSOR CECIL H. DESCH, D.Sc., Ph.D., F.R.S.

FROM the fact that several of the May Lectures delivered before members of this Institute have dealt with the structure and properties of crystals, and others with the nature of the atom, we may conclude that these subjects, once only of interest to a small number of students, are now recognised as of importance for the study of practical metallurgy.

The whole tendency of modern physics and chemistry is to dwell more and more on the atomic structure of matter. It is strange at this time to recollect that little more than twenty years ago a prominent school of physical chemists urged that atomic conceptions should be allowed to fall into the background, and that the science should be refounded on a basis of thermodynamics only. A less happy forecast could hardly have been made. Every further discovery has emphasised the fundamental importance of atomic ideas, and has justified those far-seeing men who, early in the last century, used the conception of the atom to bring order into the facts of chemical composition. We can only conceive of the structure of matter, whether solid, liquid, or gaseous, in terms of atoms and molecules. Modern physics, by giving us the electron, has revealed a structure of a finer type within the atom itself, but this has only enhanced, and not destroyed, the value of the original conception. The view expressed by Lucretius, that all matter was composed of minute particles widely separated, has proved to be the true one, although the old philosophers could hardly have guessed that the particles would prove to be so minute, and the distances between them relatively so enormous, as in the systems of electrons and positive nuclei which we picture as constituting matter to-day.

Metals, which form the special objects of our study in this Institute, are composed of crystals, but the rarity of measurable crystal faces among them has greatly delayed the application to them of the classical methods of the crystallographer and mineralogist. When it was found that the diffraction or reflection of X-rays within a crystal made it possible to determine the arrangement of the atoms within it with a high degree of accuracy, a new means of investigation, more searching than any before known, was placed in the hands of the research worker, and nowhere has it proved of more value than in the study of metals. It can now be determined which are the planes in a metallic crystal that are most densely packed with atoms, and therefore most distant from their immediately adjacent planes having the same packing. As mechanical slip commonly occurs most easily in the direction of those planes, and along one of the most

* Eighteenth May Lecture to the Institute of Metals, delivered 8th May 1928. Abridged. From the "Engineer."

densely packed lines in that plane, the direction of slip in a given crystal may usually be predicted, although certain anomalies still call for explanation.

The knowledge of the atomic arrangement within crystals has also proved of value in bringing order into the facts concerning their physical properties, such as the electrical and thermal conductivity, although this side of the subject has been less attractive to most workers than the study of deformation.

On the modern view of the atom, as a positively charged nucleus surrounded by electrons, in number equal to the atomic number of the element, and moving in orbits the shape and dimensions of which vary according to laws which are now well established, it is the outer electrons which determine the chemical properties. The most stable arrangement is that of an inert gas, such as neon or argon, and elements which can, by giving up one or more electrons, assume that arrangement are electro-positive or metallic, whilst those which can more easily reach the stable configuration by accepting electrons from elsewhere are electro-negative and non-metallic.

Atoms may be linked together by means of electrons in three different ways. The simplest is the transfer of electrons from one atom to another, in the formation of electrolytes. A sodium atom gives up one electron to a chlorine atom, so that both assume an outer structure like that of an inert gas, and a molecule of sodium chloride is formed. Or a pair of electrons may be shared by two atoms—that is, they may take up new orbits which enclose both nuclei. This is the usual manner of formation of organic compounds, but it is also characteristic of many inorganic compounds, such as solid carbon dioxide or beryllium oxide. Each of the atoms concerned contributes one electron of the pair.

Let us now turn to the crystal, the atoms in which are held together by forces of attraction, giving the crystal its cohesion, its resistance to tension and shear. At the same time there must exist forces of repulsion, so that the atoms maintain a certain mean distance from one another at a given temperature, and offer a resistance to uniform compression. When constructing crystal models, we commonly represent the atoms as spheres for the sake of simplicity and convenience, but we have to remember that their near approach in a solid may give rise to quite considerable deformation —a fact which is important for their chemical as well as for their physical properties.

The simplest type of crystal is represented by rock salt. Every sodium atom has lost an electron, and every chlorine atom has gained one, so that the crystal is not built up of atoms in their normal state, but of ions. The two kinds of atoms form two interpenetrating lattices of the face-centred cubic type, every sodium ion being equally related to six chlorine ions, and every chlorine ion equally related to six sodium ions. There are no molecules, and the structure is one of great simplicity and high symmetry.

The simple electronic unions between atoms, whether of the electro-valent type as in rock salt, the covalent type as in beryllium oxide, or the co-ordinated type as in cyolite, do not exhaust the varieties of attraction in a crystal. There are cohesive forces even between uncharged atoms. As these are represented by a term in the well-known equation of state of van der Waals, they are commonly known as van der Waals' forces, but their origin is still obscure. They have been attributed to the distortion of the electronic orbits, but their origin is of less importance than their magnitude. Irvine Masson has shown that a mixture of argon and ethylene gases, which cannot be supposed to have any chemical affinity for one another, may be as much as 8·5 per cent. more compressible than a single gas. Such forces must play a considerable part in the cohesion of solids, in which the approach of the atoms is so much closer than in gases.

The molecule as we know it in liquids and in gases has disappeared in the formation of the rock salt lattice, but it does not follow that the molecule has no meaning in the solid state. Crystals of pure metals are regarded as built up of positive ions only, the liberated electrons being in a more or less free condition, and being responsible for the electrical conductivity. Whilst at first sight simpler, the study of such lattices offers much greater difficulties from a quantitative point of view than that of crystals built up of ions of opposite sign. The space lattice of calcite is an ionic one, the ions being Ca and CO_3, the carbon and oxygen atoms in the latter ion being constantly associated in a way which recalls molecular union. Nothing has been said of the magnetic forces in the lattice, but it is obvious that there must be magnetic fields due to the moving electrons in the atomic orbits, and that forces between atoms may result, but this side of the subject is at present very obscure.

Lennard-Jones and Dent have recently calculated in detail the forces at a cube surface of a rock salt crystal. A charged ion outside the crystal would be attracted to the surface by a force which falls off rapidly as the distance increases. The van der Waals' forces, which may be exerted also on an uncharged atom or molecule, are smaller than the electronic forces near the surface, but they fall off less rapidly, so that at the distance of a few Angström units they actually exceed them. In addition, there are smaller forces due to the polarisation of a neutral atom in the electro-static field of the crystal. These several forces make it possible for atoms, ions, or molecules to attach themselves to the crystal face, more or less permanently. It will be clear that the attractions will be different, and possibly very different on different faces, partly owing to the varying closeness of packing, but also to the distribution of electronic charges. A cube plane always consists of alternate sodium and chlorine ions, but alternate octahedral planes consists only of sodium and only of chlorine ions. The chemical properties will clearly not be the same. What evidence have we that such is the case? I think the best evidence is that of the effect of impurities on the habit of crystals. Common salt normally crystallises in cubes, but in presence of certain substances, notably of urea, it forms octahedra. There is no question of a change of space lattice, but only of the relative development of different faces. If we suppose that urea is held or "adsorbed" by the octahedral planes more readily than by cube planes, the former will be rendered less able to take up salt molecules during growth, and it has been established that it is those faces perpendicularly to which growth is slowest which develop on the crystal. The process has been watched in lead nitrate.

In general, in a lattice consisting of atoms of only one kind, the residual affinity will be least on the most densely packed atomic planes, but this is subject to certain exceptions.

All reactions which depend on absorption at the surface must be dependent in a high degree on the size of the crystals. This is particularly true of reactions in which a metal or other solid is used as a catalyst in bringing about combination between gases, as in the synthesis of ammonia from nitrogen and hydrogen.

We may now consider the action of a chemical reagent, such as an acid, on a crystal of a pure metal. All the atoms are alike, so that the only differences between different planes are those of density of packing. Reagents which dissolve the metal do not, as a rule, do so equally in all directions. If they did so, a smooth surface would be etched equally all over, and would remain smooth. Actually, the surface is roughened, and examination under a sufficiently high

magnification reveals a geometrical pattern of pits or "etch-figures" which evidently bear some relation to the internal structure of the metal. Iron gives a particularly clear pattern of cubes, and bismuth gives definite triangles. The problem of the nature of etch-figures, which have been known for more than a century, is a baffling one. It is easy to understand that in so regular a structure as a space lattice, the reagent can penetrate in some directions more readily than in others and if this were all the explanation would not be so difficult. It is, however, remarkable that quite different etching patterns may be obtained by changing the nature, concentration or temperature of the etching reagent.

That the rate of solution of different faces of a crystal was not the same has long been known. A sphere or cylinder of calcite immersed in acid develops crystal faces, just as when a similar mass of rock salt is immersed in water. Very dilute hydrochloric acid dissolves calcite without change of shape, but with higher concentrations crystal faces make their appearance, and it is remarkable that these are not always planes of greatest closeness of packing. In fact, whilst metals mostly give etch-figures having simple forms, this is by no means true of minerals, especially of those of complex structure.

(To be continued.)

GREAT BRITAIN'S EXHIBITION PROGRAMME.

THE Society of Motor Manufacturers and Traders, Ltd., is already actively engaged in mapping out its programme and making arrangements for the 1928 Exhibitions in connection with the Industry.

This programme of necessity demands an immense amount of preliminary consideration and preparation, for in its efforts to maintain the position of London as the Automobile Market of the world it is faced with a task of some magnitude. The Motor Exhibition, which annually takes place at Olympia, is acknowledged throughout the world to be the Mecca of motorists, and the large number of visitors who come from all the corners of the earth to Kensington bears striking testimony to the magnetic attraction of that venue and to the appeal of motoring.

The Automobile Exhibition this year will constitute the 22nd of the series of International Motor Exhibitions organised by the Society, and will take place at Olympia from Thursday, 11th October, to Saturday, 20th October. Here it will again be possible to see, under one roof, the latest products of the automobile factories, not only of Great Britain, but of all the important automobile-producing countries of the world, while in addition to the exhibits of chassis and complete cars, the examples of the high degree of artistic workmanship of those firms whose business it is to specialise in coachwork never fail to exercise a great attraction to visitors.

It is only on the occasion of an Exhibition such as this that one is able to appreciate the range of accessories and components that go towards making the modern automobile the wonderful production that it is, and which tend, further, to make motoring easy and comfortable.

In former years, until 1927, it was the practice to reserve a day before the Exhibition opened to the public in which to afford facilities for the trade and the Press to view the exhibits, but it has been felt that the utility of this reservation has ceased. Accordingly last year this private view day was dispensed with, and this will again be the case. The charge for admission to the Show on the opening day will be 10*s.*; on the two Fridays and Saturdays during which the Show is open the charge will be 2*s.* 6*d.*; and on all other days 5*s.* On the evening prior to the opening the annual banquet of the Society will be held.

Following the Motor Exhibition the Motor Cycle and Cycle Exhibition, organised by the British Cycle and Motor Cycle Manufacturers' and Traders' Union, Ltd., of Coventry, will be held at Olympia, the period being from Monday, 5th November, to Saturday, 10th November.

Under the patronage of the S. M. M. T., the Scottish Motor Exhibition, organised by the Scottish Motor Trade Association, will be held from 9th November to 17th November, at Kelvin Hall, Glasgow.

After full consideration the Society has decided not to organise a Commercial Motor Transport Exhibition at Olympia this year, it being the general opinion of manufacturers connected with this branch of the industry that an Exhibition bi-annually is the most satisfactory policy so far as they are at present concerned. They will, therefore, content themselves by exhibiting, if they think fit, at some of the more important recognised Agricultural Shows in Great Britain.

This comprehensive range of Exhibitions will afford an excellent opportunity for the world to see in particular the latest developments in the products of the British Automobile Factories and to compare the products of this country with those from the Continent and America. It can be no exaggeration to say that the series of Exhibitions have in the past proved unquestionably that the products of British manufacturers of vehicles, components and accessories, and tyres, are second to none in efficiency and value, and it can confidently be anticipated that the Exhibitions this year will further confirm this.

Despite occasional gloomy references to the contrary there are unmistakable signs that the value and sterling qualities of British-built vehicles are becoming more and more recognised in all markets and are securing for the makers of such vehicles a position of pre-eminence therein. No one will be foolish enough to assert that the difficulties of British manufacturers, particularly in the task of recapturing the overseas markets, are at an end, but while statistics may occasionally not make quite as pleasant reading as might be desired, there are, on the other hand, clear indications that progress, although possibly slow, is certainly being made. British manufacturers, as a result of personal investigation, are more than ever alive to the requirements of overseas markets, and it now remains for the members of the industry concerned to take all necessary steps to maintain their present position and to exploit it further.

The Gazettes.

Bihar and Orissa, June 6, 1928.

Irrigation Department.

Mr. S. A. Amir, Assistant Executive Engineer, is, on being relieved of the charge of the Champaran Division, attached to that division until further orders.

Punjab, June 8, 1928.

Irrigation Branch.

Lala Faqir Chand, Assistant Engineer, on transfer from the Qaimpur Division, 2nd Bahawalpur Circle, Sutlej Valley Project, which he left on 22nd April 1928, joined the Bahawalpur Division, 2nd Bahawalpur Circle, Sutlej Valley Project, on 1st May 1928.

Lala Raghu Nath Rai, Handa, Assistant Executive Engineer, on transfer to the North-West Frontier Province, left the Sadiqia Division, 1st Bahawalpur Circle, Sutlej Valley Project, on 11th May 1928.

Mian Abdul Ghani, Assistant Engineer, on transfer from the Bikaner Main Line Division, Bikaner Circle, Sutlej Valley Project, which he left on 21st April 1928, joined the Eastern Division, 1st British Circle, Sutlej Valley Project, on the 23rd idem.

Mr. C. King, Assistant Engineer, on transfer from Mailsi Main Line Division, 3rd British Circle, Sutlej Valley Project, which he left on 1st May 1928, joined the Delhi Division, Western Jumna Canal, on the 4th idem.

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INDIAN ENGINEERING.

SATURDAY, JUNE 23, 1928.

MR. SYDNEY M. JACOB.

II.

TO summarise briefly the appointments held by Mr. Jacob in India, he was for the first seven years of his service Assistant Commissioner at Jullundur, Delhi, Sialkot, Kaithal, and Rawalpindi, and officiated for a time as Deputy Commissioner at Jhang. In 1911-13 he was Additional District Magistrate at Delhi, and in the next two years was on special duty as Inter-Provincial Boundary Officer. On the completion of this work he was Deputy Commissioner at Karnal and Jullundur till he was appointed Superintendent of the Lahore Central Jail. In 1918-21 he was officiating Director of Agriculture, and then on special statistical duty for five months was made Director of Agriculture in addition. He was Superintendent of Census Operations in 1922-23, after which he took leave and retired on proportionate pension in 1924. No sort of interest attaches to a bare record of this kind, but the list is given as it has some bearing on the special work done by Mr. Jacob in the course of his career. It will be noticed that only for a very short span of years was he employed in a way that would give his exceptional talents a chance. But that was apparently an axiom of administration in the Panjab. Sir Walter Lawrence in his delightful book, "The India We Served," mentions that the Chief Secretary of the Panjab informed him that "the great secret of administration was to ignore the personal factor, that in making appointments to Districts, it did not matter whether Jones or Brown or Robinson was appointed to a certain District. They were parts of a machine, and if they were not exactly alike, they must be regarded as alike and taught to consider themselves as alike." In the same connexion, another passage in the book, concerning Sir Edward Buck who was called, not without reason, the Grand Old Man of Indian Agriculture, may be quoted. Lord Dufferin told Sir Walter on the day he left India that "he regarded Sir Edward Buck as the great genius of his administration. But the tragedy was that the Government starved all the useful projects of Edward Buck, and money was grudged to the scientific departments and to experimental agriculture. . . . He tried again and again to persuade the Financial authorities, but they regarded Edward Buck as a dreamer and a visionary. He had vision, and he was one of the few who insisted on the right to think. Most of the Civil Service had no time to think, as the work gave no respite and no leisure." Well might George Bernard Shaw have exclaimed: "Really, England," or India for the matter of that, "does not deserve to have great men." The mediocrities of the world distrust brilliance and take a pleasure in throwing every obstacle in its way, it seems to amount to that.

But we do not know that Sir Walter was quite correct in saying that civilians have no time to think. Sir Edward Buck was a civilian and just as hard worked as any other civilian, but he found a great deal of time to think, and so did Sydney Jacob. In 1906, as sub-divisional officer at Kaithal, he applied some of the Galton-Pearson methods to agricultural statistics and arrived at a criterion for determining the fluctuating assessment of land revenue, applicable to precariously situated villages of the Naito tract exposed to violent alternatives of flood and drought. The Settlement Officer reported to Government that the calculations were interesting, and there the matter ended. In 1908, at Sialkot, he started in earnest to determine to a first approximation the equations connecting rainfall with the area of crops sown in various villages of the district. The paper was finished at the end of 1908, and it was only after it had been submitted to the Asiatic Society of Bengal that Mr. Jacob learnt that R. H. Hooker had applied the method of correlation to the similar, though distinct, problem of the effect of rainfall and temperature on the yield of wheat in the east of England. That did not make the subject of the prediction of crops of less interest, but the high officials of the Panjab appear to have found the method too scientific or that they had no time to study it. In 1910, while on leave in England, Mr. Jacob spent some time in Karl Pearson's Biometric Laboratory at the University College in working out the correlation of the head measurements of a hundred pairs of fathers and sons, which he had made on Panjabi peasants in the Amritsar District, and also in calculating the theoretical effect of inbreeding on the Mendelian hypothesis. The head measurements gave correlations far less in many cases than the 0·5 which was the usual figure about which the parental correlation varied, and Karl Pearson, though he was prepared to publish the results in "Biometrika," thought that further tests should be made. The Mendelian paper was, however, published in the Proceedings of the Royal Society.

Reverting to the problem of crop prediction, that is the quantitative relationship between the areas of crops sown at each harvest and the climate factors, Mr. Jacob had realised from the outset that any research that he could do in his spare time could only touch the fringe of a vast field of enquiry into the whole complex system of weather, crops and rural social life and economics. But at Jullundur, the Commissioner, Mr.—afterwards Sir Patrick—Fagan, relieved him of sufficient routine work to enable him to examine the crop statistics of the Jullundur District. The result was a second paper which was read before the Indian Science Congress of 1916, and in that paper the author emphasised very strongly the distinction between agronomic and agricultural meteorology. Moreover, not content with the theoretical aspect of the question only, he prepared forecasts of the area of various crops for a portion of the Jullundur District. The predictions and the extent of their agreement with the subsequently ascertained facts are shown below :—

Crop.	Prediction.	Actual area.	Percentage error of prediction.	Average variation.
Chahi wheat ...	23,000	20,698	11	21
Chahi wheat and gram ...	5,000	5,775	13	20
Other chahi crops	18,600	18,951	2	6
Total chahi ...	48,000	45,434	2·5	15·5
Total barani ...	41,000	39,141	4·8	22·2

The last column of this table shows the error that would be made by merely forecasting the area of crops from the average of the previous thirty years; and when it is remembered that the error of official forecasts of crops have often exceeded the average variation, it is clear that Mr. Jacob's formulæ were a step in the right direction. It was also at about this time that Mr. Jacob urged on Government that the new statistical methods would be of help in framing more accurate forecasts of food supplies in India, a matter which was of grave concern in the world-war.

In 1909, Mr. J. H. Field, afterwards Director-General of Meteorology in India, commenced his great series of researches on the temperature, pressure and humidity of the upper air, and chose Jhang, where Mr. Jacob was Deputy Commissioner at the time, as the most suitable spot to send up his balloons during the monsoon. Attracted no doubt by the similarity of their eagerness for research, the two officers became great friends, and subsequently Mr. Jacob spent a short period of leave at Simla, and in collaboration with Mr. Field wrote a paper on the calculation of the times of moonrise and moonset, which was published in the memoirs of the Meteorological Department. Mr. Jacob also spent another period of leave in working in the laboratory of Lieutenant-Colonel Adie, I. M. S., Chief Malarial Officer of the Panjab, together with Mrs. Adie, herself a capable parasitologist. Colonel Adie was at that time examining many hundreds of blood smears to determine the proportion of parasite-infected corpuscles. This involved a troublesome count of the number of blood corpuscles in the microscopic field, and Mr. Jacob devised a process of counting the number of corpuscles intersected by a line in the field of the microscope. An account of the method was published in the journal "Malaria," of which Major McKendrick, I. M. S., was the editor. Major McKendrick, an able mathematician, had been investigating the theory of the spread of disease, endemic and epidemic, and Mr. Jacob discussed with him the value of the Pasteur treatment of rabies, as shown by Indian statistics, and subsequently wrote a paper expressing the opinion that the Indian data were inconclusive as regarding the benefit of anti-rabic treatment and suggesting an alternative procedure.

(To be continued.)

DAMPNESS IN BUILDINGS.

MR. ERNEST G. BLAKE, M. R. S. I., Liverpool, is well known as an expert in buildings repairs and as an author of several books on the subject. Some five years ago his book on "Damp Walls" was published, and it dealt with an evil with which all engineers and architects may at some time or another have to contend. Dampness in the interior of a house is not only unpleasant, it causes damage. Carpets and other forms of floor-covering rot when there is dampness and want of ventilation, and mildew on other articles is a source of injury. In humid climates, houses should be built with damp-proof courses, and ground floors should be laid with asphalt or with cement concrete in which "pudlo" has been mixed. But, more usually, it is not a case of constructing a new house to resist damp, but of an existing house in which the mischief has already occurred. It is then a very expensive proceeding to introduce damp-proof courses into existing walls, so expensive that the action taken is generally to try and remedy the defect in other ways. "Protex" is, for instance, a substance which has been used with good effect, judging from the demonstration given at an Olympia exhibition, where a wall in lime mortar, a half-brick thick, was subjected to a steady stream of water on the outer face, and yet the inner face, protexed, plastered and papered, was perfectly dry. Floors could be treated with protex in the same way, and over it could be laid Indian patent stone, tiles or other suitable material. There are many other methods of treatment with which engineers and architects are very likely familiar, and they may have experimented with them with more or less success. If, however, they require further information they will find it in Mr. Blake's book on "Damp Walls;" and at the moment we are more concerned with Mr. Blake's latest work on "The Prevention of Dampness and Condensation by the 'Knapen' Systems."

In moist climates, the moisture in the air leads to condensation, and the evaporation of moisture is an important matter. To prevent condensation, the more effective the ventilation the better, and a Belgian engineer, M. Knapen, has devoted much study to this point. His system is not an invention of yesterday, it has been in use for some years on the Continent of Europe, but it may be new to India, and Mr. Blake gives an excellent description of it, with diagrams which make the text very clear. The method is based on certain hygrometric principles, and consists in fixing tubes in stated positions, on both sides of a building, and by their means securing very effective aeration. The method is not expensive, and it would seem to have met with great success wherever it has been brought into operation. Applications of the various soaps, silicates and other things are doubtless remedial up to a certain point, nevertheless there is moist air and condensation to contend with, and evaporation and ventilation in the elimination of dampness are of much importance. In this aim, the apertures in the walls can be introduced without either great cost or disfigurement, and the system appears to have much in its favour, based as it is on scientific principles. Mr. Blake's book on the subject is published by Messrs. Tinling and Co. Ltd. at the price of half-a-crown, and it merits the attention of engineers and architects who have to cope with the trouble in question.

MALARIA AND AGRICULTURE IN BENGAL.

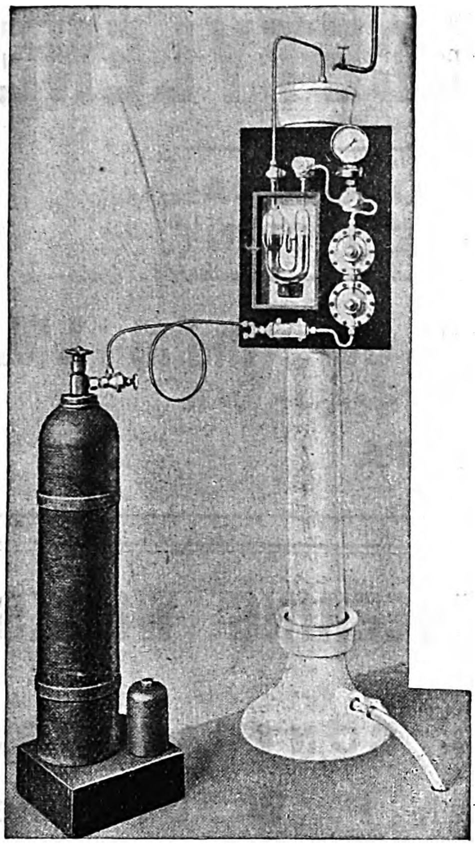
FROM the letters we have received, it would appear that the views expressed by Sir William Willcocks in his paper on "The Restoration of the Ancient Irrigation of Bengal," a paper we have recently published *in extenso* in our columns, have met with a considerable amount of incredulity and opposition. But that is not altogether surprising, there was a good deal of novelty in Sir William's forcible utterances, and irrigation engineers heard what they had not expected a brother irrigation engineer to say. He had laid down the lines of a project to restore prosperity to Bengal, and they were lines which were foreign to the traditions of irrigation in India. They were new to preconceived ideas, and being new they met with disapproval. In that context, we recall what David Christie Murray said on one occasion, he said (we quote from memory and not necessarily the exact words): "I don't care in what walk of life it is, I don't care in what department of art it is, the man who dares to look at the truth with a naked eye and tell the jumbled idiots of this planet what he sees is a fool to his own generation and a sacred inflammé to the next. I knew Tom Carlyle when he was only eccentric; I knew Bob Browning when he was unreadable. I have seen the whole crowd of newspaper nobodies shrieking at Ruskin. My father was a friend of Turner's when one of his canvases would not have fetched a ten pound note." *Damnunt quad non intelligunt*, that seems to be the size of it. But not everyone has disagreed with Sir William, it is inconceivable that the Director of Public Health should be antipathetic to him, and possibly the Director of Agriculture may have much in common with him. For the rest, though the opinions vary in degree, Sir William Willcocks appears to be regarded as an enthusiastic visionary, weaving a romance out of slender information. It is said that the picture of a very flourishing Bengal in olden times requires confirmation, it may have been a country of creeks and jungles, of crocodiles and tigers, and with a sparse population, mostly fishermen, unconcerned with co-operation except for purposes of mutual protection. The gigantic canals, if made by man, must have been made by forced labour and not by co-operation in the ordinary sense; and floods of rich red water poured over a country, receiving 5 feet of pernicious white water in the form of rain, would lead to water-logging of the soil, one of the great evils of the day. Irrigation on that scale would not combat malaria, nor would leguminous fodder crops save the

situation. There would be no water rates, just as there are no water rates in Egypt, and the fiscal system would have to be altered with a stroke of the pen. It is contended that, beyond the fact that Bengal, Egypt and Mesopotamia all have deltaic rivers, they have nothing else in common, and that the Willcocks' project is practically impossible.

But whatever the nature of destructive criticisms of that kind, it has to be admitted that the conditions of Central and Western Bengal are to be deplored and call insistently for action. Critics, who have so far only read Sir William Willcocks' paper, would do well to study Dr. Bentley's "Malaria and Agriculture in Bengal: How to reduce Malaria in Bengal by Irrigation," a publication of 1925, and Sir William's "Why is Cultivated Egypt immune from Malaria" of 1927. Without entering into any fanciful pictures of ancient Bengal, Dr. Bentley's report shows that there has been a progressive contraction of the cultivated area, there has been a loss of fertility and consequent agricultural deterioration, and in one settlement report it was stated: "It was impossible for landlords to enhance rent and to evict tenants when the fertility of the soil was declining and land was gradually going out of cultivation." Jungle has been encroaching on cultivated and inhabited areas, population has decreased, and there is the broad fact that only 58 and 60 per cent. of the cultivable area is under cultivation in Central and Western Bengal, respectively, compared with 90 per cent. in the more fortunately situated Eastern Bengal. Dr. Bentley has reviewed the position very thoroughly and at great length, and there can hardly be any question as to the agricultural deterioration, mainly for want of water, in the two subdivisions of Bengal with which Sir William Willcocks dealt. In addition, there is the malaria side of the case. "India in 1926-27" gives the deaths in Bengal from malaria as about 500,000, or 66 per cent. of the total mortality, and says that it is unquestionable that this disease remains the greatest scourge of the province. The scourge is, moreover, at its worst in Western and Central Bengal, as shown conclusively by Dr. Bentley's series of figures. It is not correct to say that Ganges' flood inundations of rich red water will not help to combat malaria or that the cultivation of legumens will not affect the situation. Dr. Bentley has fairly well established the fact that silt-laden water is unfavourable to the larvæ of anopheles mosquitoes, and apart from its value as a manure it also tends to destroy aquatic vegetation which would otherwise afford mosquitoes shelter. Further, it is believed that freely-grown leguminous crops have a most beneficial effect in rendering a malarial tract immune from malaria, for in no other way is it easy to account for that immunity in Egypt, the Argentine and elsewhere. Regarding the engineers' fears of water-logging the tracts it is intended to benefit by inundation irrigation from the Ganges, the danger is mainly imaginary. In spite of the favourable rainfall of Bengal, the fertile sediment carried by the flood water of the river is far more likely to do good for agriculture and for checking malaria than harm by reason of excessive flooding. As long as the water has a free outlet and is not held up by obstructions, it will have the beneficial result of basin irrigation in Egypt. The alteration of the assessment system can hardly, merely because it is an alteration, be held to be an objection. If a better system for Central and Western Bengal can be devised, it is to confess ourselves hidebound by precedent if we allow ourselves to be intimidated by the prospect of a change.

Sir William Willcocks may be an enthusiastic visionary, but though he may have the spirit of romance in him, his record shows that he has not allowed it to overpower his practical instincts. Enthusiasm is an asset in a world where work is often dull, stale and unprofitable; and visionaries of action, not those who merely dream idle dreams, are what the world wants more than any other class of man. His scheme is not impossible, and engineers would do well not to allow the word "can't" a place in their vocabulary. It will be difficult, there will be engineering difficulties, some of them of a novel kind, and there will be administrative difficulties and legislation to meet with the requirements of a new situation. But that does not mean that they cannot be overcome, and a successful project on the lines Sir William has formulated would be a stimulus to irrigation in India which is once more in a stage of depression, owing to faulty projects. If the Bengal engineers are alarmed at the prospect of the complete scheme, it is possible that experimental measures might be tried in Western Bengal, as a beginning. Sir William has said that the proprietors of this tract have the first claims on public funds, and has suggested that in the first year it will be enough to begin from the left embankment on the Damodar downwards to the last canal north of Jamalpur. His services could no doubt be enlisted for advice from time to time, and periodical visits of an engineer of his great ability, if he could be induced to make them, would be invaluable in giving confidence during the early stages of the work. Sir William has never been wanting in the audacity which was Sir Colin Scott-Moncrieff's motto in Egypt, and a good beginning would be half the battle of the enterprise.

An All-Steel Type of Railway Coach.—The Barsi Light Railway has had a number of coaches built by the Leeds Forge Company, they are of various kinds inasmuch as they comprise first and second class composite carriages, second and third class composite, two different designs of third class carriages, and a brake, road van and postal carriage. But all the coaches are constructed of steel without any woodwork in the structure, they are for a 2 feet 6 inches gauge, and have a length over buffer of 45 feet, width over waist rail of 7 feet 3⅛ inches, and height of 9 feet 8 inches. They are provided with the Stone's system of electric lighting and with vacuum brakes. We hear very good opinions expressed of these coaches, and they are likely to be economical in use from their all-steel design, though of course wood is used in the interiors.



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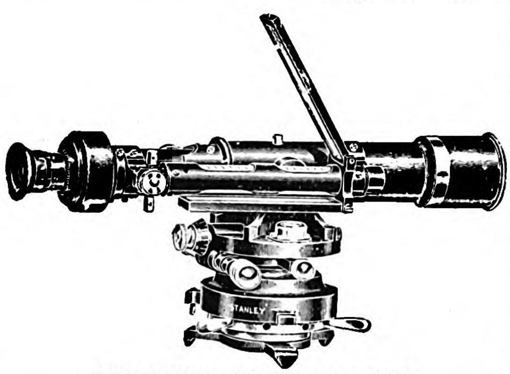

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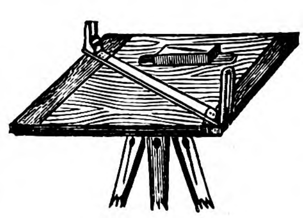

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Notes and Comments.

Longest Concrete Roadway.—A new record for road construction has been set by America in the 195-mile continuous stretch of concrete road laid in Alabama. The 135-mile section on the Minnesota highway was previously rated as the longest in the world.

Tata Steel Production.—Messrs. Tata Sons, Ltd., Agents of the Tata Iron and Steel Company, Ltd., report that the total approximate production of the Steel Works at Jamshedpur during May was :—Pig iron 43,810 tons, steel ingots 43,033 tons, and finished steel 19,058 tons.

Air Mail to India.—Speaking at a dinner at Edinburgh on the 15th instant, Air Vice-Marshal Sir Vyell Vyvyan said that the Imperial Airways had recently concluded a contract with the Government for the conveyance of air mails to Karachi in seven days and to Calcutta in nine days.

New British Airship.—A great British airship, R-100, is nearing completion, and will be launched in July next. It has a 5,000,000 cubic feet capacity Rolls-Royce engines and accommodation for 100 passengers. After the Air Ministry tests have been passed, a flight in early autumn will be made from England to Canada and New York and back to England.

British Flying Boats.—A contract for six large flying boats of the Southampton type for the Argentine Navy has been placed with the Super-Marine Aviation Works of Southampton. Five of the machines will be fitted with wooden hulls. The sixth machine will be constructed of metal. A contract has also been placed for a similar flying boat for early delivery to the Japanese Navy.

New Railway Lines.—The Railway Board have sanctioned the construction by the North Western Railway of the following railway lines, on the broad gauge, of an aggregate distance of about 162 miles :—A loop line from Mehrabpur to Pad Idan, *via* Tharushah ; a loop line from Nawabshah to Tando Adam, *via* Bakrand and Hala ; and a chord line between Tharushah and Bakrand.

New World Speed Record.—After a thrilling race at le Mans, France, a British Bentley automobile driven by Captain Barnato and Mr. Rubin, two English amateurs, won a 24 hours' race over the Sarthe circuit, defeating French, Italian and United States competitors, and breaking the world's record for distance covered in 24 hours. The distance completed was 1,684 miles. The Bentley finished about 60 miles ahead of its next competitor. Last year's race was also won by a Bentley car, driven by Messrs. Benjafield and Davis.

New Beam System.—Further developments in the use of the Marconi short wave beam for Imperial communications occurred on the 16th instant, when beam stations built for communication between, Canada and Australia, were opened to public service. The development will assist the mutual business interests of the two Dominions and will add a further link to the system of beam wireless communication between Great Britain and Australia. At present beam messages from England to Australia can be transmitted over two routes direct. With the opening of the Canada-Australia service a third route will be added by which a message can be relayed through Canada in case of need. Beam traffic between Britain and Australia has steadily increased and now approximates to nine million words annually.

Calcutta-Baruipur Bridge.—This new bridge over Tolly's Nullah at Gariah, 7 miles from Calcutta, has been opened to traffic. It is at the southern end of the Gariahat Road, and connects Calcutta with Baruipur, the chief centre of the city's vegetable supply. Owing to various circumstances the work was not started till October last. The bridge, which is under the control of the Irrigation Department of the Bengal Government, has been built at a cost of about Rs. 65,000. It is 111 feet long with a width of 20 feet for wheeled traffic, and a 6 feet broad footpath on each side.

Another Beam Line.—The establishment of the first direct wireless circuit between North America and Australia was heralded on the 16th instant by the exchange of messages of felicitations between the Governments of Australia and the United States, and also between officials of the Press Associations of the two countries. The Canadian Premier, Mr. Mackenzie King, exchanged greetings with the Premiers of Tasmania, Victoria, Queensland, South Australia and New South Wales. Messages came by beam wireless from Melbourne to Montreal, whence they were relayed on short waves to Washington.

Bengal-Nagpur Railway.—This railway have recently opened additional premises alongside the existing booking and parcel offices of the railway on the Esplanade, Calcutta. An innovation is the provision of separate booking offices for inter and third class passengers, while a special feature has been made of accommodation for first class. All information regarding tickets, parcels and timing of trains can be had at the new branch. The scheme was completed under the direction of the Bengal-Nagpur Railway architect, Mr. B. Matthews, and the Britannia Building and Ironworks, Ltd., and Messrs. Mansfield and Company were responsible for all woodwork and furniture.

Railway Earnings.—The total approximate gross earnings of all State-owned railways for the week ended 2nd June 1928 (ninth week of the year) amount to Rs. 204 lakhs, Rs. 5 lakhs less than the figures for last week and Rs. 2 lakhs less than the figures for the corresponding week of the previous year. The total approximate gross earnings up to 2nd June 1928 amount to Rs. 19·37 crores, or Rs. 66 lakhs more than the figures for the corresponding period of the previous year. A comparison with the figures of the previous week show decreases in the approximate gross earnings of all railways except the Eastern Bengal and North Western. Compared with the figures of the corresponding week of 1927 all railways except the Assam-Bengal, Bombay, Baroda and Central India, Eastern Bengal, Madras and Southern Mahratta, and South Indian show decreases in their approximate gross earnings. The principal decreases were on the North Western Railway, Rs. 2¼ lakhs, due to coaching traffic and less receipts under wheat, metal and other commodities; and on the Bengal-Nagpur Railway Rs. 2 lakhs, due to coal, manganese ore, salt timber, sugar and jagree.

Badnera-Amraoti Branch Extension.—The Railway Board announced on the 12th instant their sanction, to the proposal for the construction of a railway line between Amraoti and Narkhed which was approved by the Railway Standing Finance Committee at its recent meetings in Bombay. The proposed line, which is about 79 miles in length, is an extension of the Badnera-Amraoti branch of the G. I. P. Railway. The alignment now selected differs from that originally surveyed in 1906-07, in that it proceeds *viâ* Chandur Bazar in a north-easterly direction to Morsi and Narkhed instead of direct to Morsi from Amraoti. It will traverse a fertile area having a population of 258 persons to the square mile. The financial prospects of the line in the sixth year after opening have been estimated to yield a return on the capital cost of 6·5 per cent.

Electric Locomotive.—The trial run of this new electric passenger locomotive of the Great Indian Peninsula Railway has been successfully accomplished. The train after leaving Victoria Station and passing between Musjid and Byculla Stations speeded up and attained 70 miles per hour with a load of 256 tons. The locomotive, however, is capable of a maximum speed of 85 miles per hour. The new Kalyan power house is intended for main line electrification purposes and the power generated will be utilised from Kalyan onwards, on both the main sections, namely, Kalyan to Poona and Kalyan to Igatpuri, with 13 sub-stations distributing power. It is designed for producing 40,000 k. w. in four sets of 10,000 k. w. This will eventually make the Great Indian Peninsula Railway independent of steam power traction between Bombay and Igatpuri and Bombay and Poona.

Sarda Canal Project.—Satisfactory progress is being made on this canal in the United Provinces. This scheme will cost Rs. 9½ crores and when completed towards the end of this year will consist of about 4,000 miles of canal and distributary channels commanding an area of about seven million acres, of which about 1½ million acres will be irrigated in dry years. Although the country which will receive water is already highly cultivated the introduction of canal irrigation will lead to a better class of crops being grown, especially to the development of sugarcane, and will eventually become one of the most important sugar producing centres in India. Fears have been expressed as to water-logging but precautions have been taken to obviate this. Construction in the upper reaches of the canal has been carried out under great difficulties. The project is estimated to bring a net return including enhanced land reveuue of 67 lakhs in average years, or 7 per cent. on the capital outlay.

Tolly's Nullah Bridge.—The Calcutta Corporation have under consideration a scheme for the construction of a fixed girder bridge over Tolly's Nullah, opposite Chetla Central Road, at a cost of Rs. 5,37,000. In 1915 the E. B. Railway proposed, on behalf of the Port Commissioners, to divert the section of the railway line between Kalighat and Santoshpore on the Budge-Budge Branch of the E. B. Railway, which would affect Russa Road, Chetla Road, Tolly's Nullah, Tollygunge Circular Road and Tollygunge Road. It appeared that the railway line after it crossed Tolly's Nullah would affect municipal interests on the west of the Nullah. The railway authorities wanted to close Tollygunge Circular Road and to construct an alternative route, but the then Chairman of the Corporation held that the only efficient substitute for the present route would be by way of a new bridge over Tolly's Nullah. Various schemes were put forward and eventually it was decided to have a fixed girder bridge. Since December last the Improvement Trust have been urging the Corporation to proceed with the construction of the bridge, adding that they were in favour of a high level bridge as the Public Works Department stressed the necessity of the bridge being closed to vehicular traffic for prolonged periods at high tide.

Coals to Newcastle.—A correspondent of "The Times Trade and Engineering Supplement" mentions the importation of rice into India as a startling proposition. So it is; India also imports sugar to a very large extent when she should be capable of producing all the sugar necessary for her own requirements. But rice! it would certainly seem to come within the category of carrying "coals to Newcastle." The broad acres under rice every year in Bengal, Madras and Burma, to say nothing of the rice cultivated in other provinces which in aggregate is fairly extensive, would seem to preclude any possibility of other countries being able to find purchasers in the very home of this cereal. But it is said that "both Saigon and Japan have been selling rice to India this season at prices with which Burma exporters, owing to the high prices demanded by the cultivator for his paddy, cannot compete. This is the first time in history that Saigon and Siam rice have been imported into India." It is also said that there is a danger of Burma rice being driven out of Western markets owing to the expansion of rice cultivation in Southern Europe and America. There is something wrong in this, and Burma will have to lower her prices if she is not to suffer by a falling off in her rice trade, preferably no doubt by increasing the yield per acre by improved methods of cultivation.

The DOX Airplane.—This is a gigantic airplane with twelve engines and a total of 5,000 h.-p. The Dornier seaplane works are building a Transatlantic 'plane known by the cryptic name of DOX at Altenrhein, in Switzerland, the company having set up special workshops on the Swiss side of Lake Constance in order to avoid complications with the *Entente.* No airplane or seaplane has hitherto had more than four motors. The twelve motors of the DOX will be arranged in six tandems of two each and will have twelve propellers. The Aquitania of the air will thus have a motor power double that of the great Zeppelin airship LZ127, which is nearing completion in the yards at Friedrichshafen. German airmen hope that the new giant air liner, which is to make a trial trip across the Atlantic during the summer, will inaugurate a regular passenger air service between Europe and America. The DOX will be able to land on the water, and is built so strongly that it will be able to defy the rage of the open ocean. It will carry from 25 to 30 passengers as well as a certain amount of freight, in addition to the large quantities of fuel for the supply of the twelve motors. The crew will consist of a Captain, two Pilots, two Engineers and a Wireless Operator, and the chartroom will, with its equipment of nautical instruments, resemble that of an ordinary ocean liner.

The Great Pyramid.—We are asked by "Σ. Φ." with compliments to that journal to reprint the following letter which appeared in the "Times" of the 29th May 1928. He says he wrote himself to the Editor to point out that any proof of a time-chart must rest upon a record of notable Astronomical predicted events, and that in any case the marked halving of the Ante-Chamber completely upsets any current interpretation of the length record after passing the Great Step. We make no apology for reprinting the letter, since the "Times" thought fit to publish a reassuring editorial. A great many persons regard these "Prophecies" with dread; and the effect on business is disturbing, to that extent.

PYRAMID "PROPHECIES."

TO THE EDITOR OF THE "TIMES."

Sir,—Seeing that you have noticed, in your issue of yesterday, the "prophecies" of some world catastrophe to arise or begin on 29th May, I hereby venture, in the interest of truth, and to prevent a public scare, to set forth some established facts which upset the fallacy of the Great Pyramid interior passages having any chronological significance.

My qualification for doing so is that I suppose there is no one living who has such an intimate acquaintance as I have with the interior passages and chambers of the Great Pyramid, acquired over 50 years ago, when I was resident engineer erecting the Ghizeh Bridge on the main road to the Pyramids, and subsequently while living for some months in a tomb on the Pyramid hill. At that time, accompanied by the late Dr. James Grant, of Cairo, I spent many days and nights in measuring and drawing down the lengths and particulars of all the entrances and the first ascending passage and grand gallery, as well as the King's and the Queen's Chambers. These measurements revealed many notable features, and culminated in the discovery of two unsuspected channels from the Queen's Chamber, that will remain self-evident as long as the Pyramid lasts.

These researches we carried out in close correspondence with Professor Piazzi Smyth, F. R. S., Astronomer Royal for Scotland, who about this time first promulgated his fanciful theory of a chronological significance in the measures. We could, however, find no trace of any such significance, nor any prophetic reference. And there is not any point from which they may be presumed to start. Hence the whole chronological theory collapses.

Yours faithfully,

May 27. WAYMAN DIXON, M. I. C. E.

How Motor Engines are Tested.—"This car should be driven carefully for the first 1,000 miles" is a piece of advice that happily tends to become out of date. The reason is the perfection of the modern motor engine testing plant which does the work that is sometimes left to the client. Take, for instance, the electrical testing apparatus used at the Armstrong Siddeley factory in Coventry. In this case the engine drives a dynamotor and dials on the facia of the plant indicate not only the horse-power but the revolutions per minute attained by the engine. Below these dials are coloured lights which are switched on automatically one by one, and indicate various phases of the test. Below the lights is a wheel that controls the resistance, while conveniently arranged on the side of the engine are the throttle lever and the control switches. Consequently everything is directly under the hand and eye of the mechanic in charge. In the case of the Armstrong Siddeley tests, the engine is started by using the dynamotor as a motor, the horse-power absorbed being registered on the dial and one of the lights being lit to show that the current is driving the engine. The mechanic then presses another switch and the engine is speeded up and run on gas, and as soon as this takes place and the throttle is opened the first light goes out and another one is lit, thus showing that the engine is driving the dynamo and generating current. The horse-power needle travels from the motoring to the generating side of the dial and the r. p. m. are also noted. After an hour's test the engine is stopped and the mechanic carefully goes over it and makes any adjustments that are necessary. Lastly, there is half an hour's final power test on petrol during which readings are taken at three different numbers of revolutions. Even these tests do not complete the routine through which the engines must pass, for as soon as they meet the transmission unit in the chassis a power test is taken at the rear axle, thus testing the engine and transmission together. The latter has already received an electrical test during which it has been run in, tuned up for silence and brake adjustment, so that the function of the chassis dynamotor test is merely to see that the principal units of the car work well together. After these tests the chassis goes on the road and receives two or three runs during which it is finally tuned up.

Industrial Uses for Surface Combustion.—The commercial application of the surface combustion of gas by the Cox system continues to make steady progress and highly satisfactory results are reported from an ever-widening sphere of utility. In the Cox system, which is controlled by the Metropolitan Fuel Co., Ltd., of Westminster, London, the most important factor is the porous refractory medium through which the mixture of gas and air is passed before being lighted on the opposite side. Owing to the fact that the Cox Ignite Combustor, as this medium is called, can be made to any size or shape, whether regular or irregular, combined with the many other advantages of surface combustion, the potentialities of this system are enormous and its progress is being followed with the greatest interest both at home and overseas. In the textile industry combustors have been very successfully employed for singeing cloths, and a number of repeat orders have been received by the manufacturers for additional plant for this purpose. Similarly, as the result of the successful operation of the first apparatus working on this system for shrinking on railway tyres, further orders have been placed by one of the leading British railway companies. For tempering saw blades, the blades are carried through a tunnel by a continuously moving chain during which time they are subjected to heat treatment by the Cox system. Wire tempering and galvanising by lead baths and direct radiant heat are further examples. In the case of enamelling and japanning ovens where the question of heat regulation is of the utmost importance, this system is ideal, for heat control can be carried out thermostatically or by time switch and the margin of variation can be brought as low as 2 per cent. plus or minus. Further, by these means it is possible to effect a saving of as much as 40 per cent. over ordinary gas ovens. Obviously, this is a case where economy cannot be judged by first costs, but in the light of maintenance and running costs. In another sphere altogether a trial petrol gas set has been supplied to the Royal Army Service Corps for cooking purposes and is to be mounted in a 6-wheeled lorry in order to make it as mobile as possible. It is significant that the chief engineer of the British-American Tobacco Co. has circularised all its branches throughout the world advising the adoption of the Cox system for drying tobacco and soldering tins. This strong recommendation is the direct outcome of the highly satisfactory results secured at the main British factory of this great company.

Current News.

MR. E. FRASER has been confirmed as Chief Engineer, G. I. P. Railway.

MR. S. BANERJI has been appointed Divisional Engineer, Wireless Branch.

THE Fuel Economy Committee appointed by the Railway Board have submitted its report.

MR. J. M. D. WRENCH, officiating member of the Railway Board, is granted 8 months' leave.

DR. S. R. SAVUR is appointed on probation Meteorologist in the Indian Meteorological Department.

THE scheme for the lighting of Bally by electricity is completed and will come into operation from 1st July.

WORK is about to be started on the construction of a large power plant on the Estevan coalfield of Saskatchewan.

IT was reported at Newcastle that an order for 10,000 tons of coal for the Athens gas works has been placed in Turkey.

THE adjudication for the supply of 140,000 tons of coal to Egyptian State Railways has been postponed until August.

WORK has been started on the exploitation of the sulphur deposits at Kana Petih, Java. The output is expected to be about 10,000 tons a year.

MR. A. C. GIRDWOOD, Dredging Master, to act as Deputy Chief Engineer. Reclamation Branch, Dredging section, Bombay, in addition to his own duties.

THE services of Mr. Ali Ahmed, Executive Engineer, P. W. D., Assam, are placed at the disposal of the Delhi Public Works Department for two years.

THE Railway Board have sanctioned the construction by the South Indian Railway of a metre gauge line from Pollachi to Palghat, a distance of 33·22 miles.

THE Wanderer Gold Mine, Rhodesia, is to be reorganised and equipped with machinery capable of dealing with from 25,000 to 30,000 tons of ore per month.

ON termination of the officiating appointment as Chairman, Aden Port Trust, Mr. Salman Budruddin Tyabji is appointed as Executive Engineer, Satara Division, P. W. D., Bombay.

A PLANT for the concentration of phosphate rock by the flotation process is to be put up in the Zoutpansberg district of South Africa. The phosphate is to be sold as a fertiliser.

A PRESS communique states that the Tariff Board office will close in Rangoon on 25th June, and re-open in Calcutta on 28th June at No. 1, Council House Street, until further notice.

A COMPANY has been formed to mine the pitchblende of Haliburton County, Ontario. The ore is said to compare favourably with that of the Belgian Congo as regards its radium content.

LIEUTENANT-COLONEL R. H. PHILLIMORE is appointed temporary Director of the Survey of India, *vice* Lieutenant-Colonel C. M. Browne, confirmed as Director of the Railway Department.

THE total sales of electric energy from the Shanghai Municipal Department during the year 1927 amounted to 400,343,385 units. The staff comprises approximately 3,800 hands, of which about one-tenth are Europeans.

SIR HENRY THORNTON, Chairman and President of the Canadian National Railways, has accepted the invitation of the Council of the League of Nations to become a member of the League's Railway Committee.

INFORMATION has reached Chinsurah, the headquarters of the Burdwan Division, that the Damodar, an important river in the Hooghly District, and the Cossaye, a river in the Midnapore District, have risen owing to heavy rain.

As a sequel to the contract with an American-German syndicate, the Department of the Persian Railway Administration has been greatly curtailed, and contracts with the Director-General and other American officials have been annulled.

MR. N. G. HUNT (of Messrs. Greaves, Cotton and Co., Ltd.), has, under the prescribed regulations, been elected to represent the Bombay Chamber of Commerce on the Bombay Improvements Committee in place of Mr. F. C. M. St. Paul, resigned.

SIR CLEMENT HINDLEY, Chief Commissioner for Railways, who left India last December and while on leave made an extensive tour in East Africa, the Sudan, Egypt and Palestine, returns to India on 29th June from England and will proceed to Simla.

THE water power on the Bow River, Alberta, at its junction with the Ghost River has been leased to the Calgary Power Company. The additional power secured will be sufficient to provide for the requirements of the Calgary Power Company for the next five years.

IT is understood that the scheme for water works at Bansberia, in the district of Hooghly, which was approved by the Engineering Branch of the Public Health Department, is awaiting the sanction of the Government of Bengal, Ministry of Local Self-Government. The jute mills within the municipal area have agreed to contribute towards the water works fund.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

PRINCIPLES OF ROADMAKING.

SIR,—I have read with great interest the article on "Principles of Roadmaking" by Mr. G. C. Bannerjee, Consulting Engineer, Alipore, Calcutta, that has appeared in your journal of the 9th June 1928. This will serve a very useful purpose in determining the load and speed permissible on a very good macadamised road, a tar macadamised road, a stone sett road which abound in Calcutta. The table given in his graphs of speed and resistance of wheel carriages on macadamised road differs however from the one given by Tredgold. According to Tredgold the following table shows the relation of speed and traction of a horse on a macadamised road.

Rate in miles per hour.	Traction in lb.
2	166
3	125
3½	104
4	83
4½	62½
5	41⅔

According to Tredgold's table a horse can draw a ton on a road whose coefficient of friction is $^1/_{30}$ at a rate between 4 and 4½ miles per hour. According to the table given by Mr. Bannerjee, the same load can be drawn by the horse at the rate of 8 miles per hour. Tredgold's table also shows that with the increase of speed, traction of the horse decreases whereas Mr. Bannerjee's table shows that with the increase of speed traction of the horse increases for a speed from 1 to 8 miles per hour and then it decreases. Unless Mr. Bannerjee proves his table of graphs correct, it is very difficult for one to make use of it. I hope he will be able to do so in his next article.

A. L. CHANDRA.

Literary Notices.

Telephone and Power Transmission.—By R. Bradfield, B. A. (Cantab.), late of Engineering Department, General Post Office, and W. J. John, A. R. C. Sc., A. M. I. E. E., Lecturer in Electrical Engineering, East London College. London: Chapman and Hall, Ltd. 1928. Price, 21*s*. net.

The general introduction to this volume states that there are a number of excellent treatises in existence dealing with the propagation of electric waves along lines. The present book, however, is not so much a treatise as a series of notes on lectures delivered by the authors to students of the London University, and the object specially aimed at is to present the subject in as concise, simple and practical form as possible. Their experience is that the books already in existence are apt, by their very completeness, to give the impression that the matter is one of considerable complexity and beyond the grasp of practical engineers not well equipped with a thorough mathematical training. This is not the case. The general theory is simple, and the only stumbling-block is the use of complex hyperbolic functions without the aid of which the problems are practically insoluble. But this difficulty is far more apparent than real, since it is quite unnecessary to form any mathematical conception of those functions in order to be able to use them for the purpose in hand. Once it is realised that they are far more formidable in appearance than in reality and are merely an useful tool requiring no great skill in manipulation, the difficulty largely vanishes. It has been the authors' aim, therefore, to write for that vast majority of students and practical engineers who are engineers first and mathematicians only in so far as their profession demands. They have, therefore, assumed a minimum of mathematical knowledge and have commenced with an introductory chapter in which the use of Vectors and Hyperbolic function is explained. Once this chapter is thoroughly mastered there should be no difficulty in grasping the theory of Transmission dealt with in chapter II, and the reader is then in a position to apply his knowledge to any of the practical directions in which it is now so valuable. The first of these applications is to the problems arising in long-distance telephone transmission, and the remainder of Part I is devoted to this subject. It was indeed for this purpose that the theory was originally developed, and Telephone Engineers were amongst the first to recognise its extreme practical importance. It is no exaggeration to say that the result has been a complete revolution in the methods of long-distance telephony, accompanied by a vast reduction in cost and gain in efficiency. The book is a valuable addition to the literature on the subject.

P. W. D., UNITED PROVINCES.

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1. *Qualifications.*—The applicant must possess the qualifications required for the Corporate Membership of the Institution of Electrical Engineers. He should have had five years' experience in responsible charge of important electrical works. The five years' experience must not include any term of pupilage or apprenticeship.
2. *Age.*—The applicant must be under 30 years of age.
3. *Pay.*—Monthly rates of pay—

Age last birthday.	Pay.	Age last birthday.	Pay.
23	375	31	675
24	425	32	725
25	475	33	775
26	525	34	825
27	525	35	875
28	575	36	925
29	625	37	975
30	625		Maximum pay.

Increments will become due at the end of every completed year of service, subject to the limit of maximum pay, and will be given for approved service only. After the first increment has been admitted by the United Provinces Government, subsequent increments may be drawn on the dates on which they are due provided that they are not withheld by competent authority.

4. *Terms of Appointment.*—The appointment will be for a period of five years in the first instance, subject to six months' notice of termination of service on either side. At the end of five years, the agreement will be renewed or extended or the officer will be appointed permanently. Subject to the above terms, the appointment will be permanent non-pensionable, and the officer must subscribe monthly 1-12th of his salary to the General Provident Fund. Government will add half-yearly a bonus of 100 per cent. of his subscriptions.
5. *Leave.*—During the currency of his five years' agreement the officer will be entitled to—

   (a) Leave on average pay up to 1-11th of the period spent on duty, up to a maximum of four months at a time, to which may be added leave on medical certificate on average or half average pay up to a maximum of three months reckoned in terms of average pay; and

   (b) Three months' extraordinary leave without pay in addition to the above.

On the expiry of the contract if he is taken in permanent employment he will come under the ordinary or special leave rules as the case may be, under the Fundamental Rules.

6. *Daily and Travelling Allowances.*—On appointment he will draw travelling allowance, etc., according to the rules framed by the United Provinces Government.

Applications must reach the undersigned not later than 30th June 1928. Applications from those already in Government service must be submitted through the candidate's departmental superior officers.

H. A. LANE,
SECRETARY TO GOVERNMENT,
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INDIAN PATENT RIGHTS.

NOTICE is hereby given that the Proprietors of Indian Patent No. 9582, dated 9th August 1923, for **"Improvements Relating to Point and Signal Operating Mechanism for Double Wire Transmission,"** No. 9755, dated 26th October 1923, for **"Improvements in Electric Relays,"** No. 9756, dated 26th October 1923, for **"Improvements Relating to Track Signalling Apparatus for Railways and the Like,"** and No. 10462, dated 23rd July 1923, for **"Improvements Relating to the Operation of Railway Points and Signals and the Like,"** being desirous of exploiting the same in this Country, are prepared to grant Licenses for the working thereof in British India on reasonable terms. Full particulars may be had on application to—

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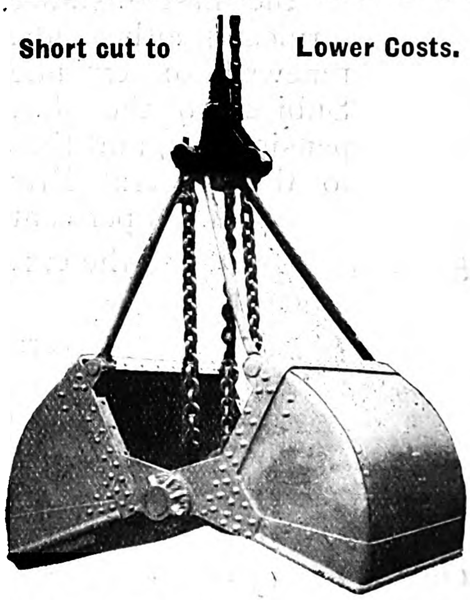

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Foreign Notes.

An Electro-Mechanical Digger.—An electric power shovel, with a dipper that will gouge out 15 cubic yards, or nearly 24 tons of earth, in one bite, has been ordered by the United Electric Coal Company of Danville, U. S. A., from the Marion Steam Shovel Company; it will be electrically equipped by the General Electric Company of America, and is to be used in the open pit mining of coal in Illinois. The shovel boom will be 120 feet long and the dipper stick 82 feet long. Thus it will be able to lift material to a height of from 90 to 100 feet, and will be able to reach out over a radius of 150 feet from the centre of operations, covering a circle 100 yards in diameter. All the shovel operations will be controlled by one man, by means of three hand levers and one foot pedal. Power will come to the shovel through a trailing cable.

Defective Continental Rails in South Africa.—A remarkable report has been published regarding the experience of South African railways in the recent purchase of rails from Continental makers. It is stated that orders were placed with a Belgian firm for rails for 250 miles of track, and that on delivery they were found to be largely defective. After protracted negotiations, the Belgian firm are reported to have agreed to replace free of charge 18 miles of rails, valued at £14,500, and also to replace any breakages within the next six years, against which they have lodged £10,000 as security. Expert investigations into the cracking of rails of several other nationalities in the Natal electrified section, have shown that they are unable to stand locomotive strains on the curves, and suffer from the action of electrolysis. It is noteworthy that apparently no British rails were involved.

Electric Tugs for the Panama Canal.—Two Diesel-electric tugboats which have for some time been under construction for the Panama Canal will soon be in commission. Each boat has an overall length of 150 feet, and is equipped with two 6-cylinder 480 h.-p. Diesel engines built by the Ingersoll-Rand Company, each directly connected to a 330-kw., 257 r. p. m. main generator and a directly connected auxiliary generator of 50 kw. The latter will supply power for running auxiliaries, lighting the boat, etc., and will also act as an exciter for the main generator and the propulsion motor. All the electrical equipment was furnished by the General Electric Company of America. The propulsion motor is a 750 h.-p., single armature, 150 r. p. m. shunt-wound motor controlled by the variable voltage method from the pilot house. Among the electrically operated auxiliaries are a hydro-electric steering gear, an air compressor, and a fire pump.

Electrocution of Plants.—The struggle for life of a plant in an "electric chair" was watched by a large audience at University College, London, recently during a lecture by Sir Jagadis C. Bose, the Indian scientist, who exhibited his new magnifying recorder. In one experiment a piece of living stem of a plant was securely strapped by metal bands to what was described by the speaker as his "electric chair." By means of a spot of light reflected on a screen, by which the plant's movements were magnified, the audience saw the plant twitch under a weak electric shock. As soon as the circuit was completed a rattling sound showed the passage of death-dealing electric current through the plant, the convulsive movements of which gradually stilled, indicating that it had been killed, say the "Daily Mail." In another experiment the audience watched the rhythmic pulsations of the plant's "heart" in pumping the sap. The plant when dosed with a dilute poison showed death spasms, but revived when an antidote was applied.

Step-down Transformer Station in Canada.—The first 220,000 volt step-down transformer station in Canada is now being built by the Hydro-Electric Power Commission of Ontario at Leaside, a suburb of Toronto. This is the receiving end for power being transmitted over 200 miles from the Gatineau power project at Paugan Falls, on the Gatineau River, north of Ottawa, in the Province of Quebec. The transmission line has been under construction since last autumn. The new transmission station when completed will be one of the largest single stations on the continent. The site covers 12 acres, and the battery of transformers will be of the largest practicable size. The buildings will be of brick and concrete with structural steel framework. The manufacture of the electrical equipment is well under way at factories in Peterboro, Toronto, Hamilton and St. Catharines, and the structural steel is being fabricated at Toronto and Walkerville. The progress schedule requires the first portion of the station to be ready to receive power by 1st October 1928.

Cathode Ray Oscillograph.—An improved type of cathode ray oscillograph for use in making laboratory and field measurements of transient electric phenomena has been introduced by the General Electric Company of America. The distinguishing feature of the instrument is its portability, and the fact that it is entirely self-contained, requiring nothing from outside than a source of 110-volt alternating current. The instrument consists of two units, each mounted on a separate truck. The first unit contains the photographic recording apparatus and high-vacuum pump, while the second includes the rough vacuum pump, synchronous switching mechanism, and cooling water system. The two units together weigh about 700 lb., and each occupies about the same amount of space as an office desk. The oscillograph is of the high-voltage cold cathode type, operating on 30,000 to 60,000 volts, supplied by a transformer. The tube is built into the end of a metal bell which contains the film holder, and the whole interior is exhausted of air during operation. When excited, the cathode of the tube emits a stream of electrons which traverse the length of the vacuum chamber and impinge upon the film. The stream is acted upon by a number of electro-magnetic and electro-static fields imposed on it by means of several sets of electro-magnets and parallel plates, so that both voltage and current waves may be recorded. When transients of very short duration are to be photographed, the beam is given an undulatory path across the film by the action of an electro-static field supplied by a high-frequency oscillator included in the unit.

Diatomaceous Earth in Admixture with Concrete.—The use of diatomaceous earth in admixture with concrete is, according to a report recently issued by the Mineral Resources Committee of the Imperial Institute, a comparatively recent development, which has not yet been much recognised in this country, probably because it is not widely known. It is employed in this way to a large extent in the United States and the consumption is increasing, and it seems not unlikely that this industry will ultimately consume a large proportion of the earth produced. The effect of the addition of diatomaceous earth to a concrete mix is to improve the consistency of the batch. It is claimed that, by the addition of about 2½ lb. to 4 lb. of finely divided diatomaceous earth to each 100 lb. of cement in the mix, the plasticity is greatly improved, and a much drier concrete of improved workability is produced. It is further suggested that a more uniform distribution of cement and aggregate is obtained by this means, and that this uniformity is maintained for a long time, there being much less tendency for settling to take place, so that a batch may be mixed in one place and transported by rail or lorry to the point where it is to be laid without the water coming to the surface and the aggregate settling to the bottom. An increase in strength and economy in total cost is also claimed to result from the addition of diatomaceous earth.

An Egyptian Hydro-electric Scheme.—The production of electricity on a large scale is the prospect opened up by a report of the Desert Survey Department of the Egyptian Government on the subject of the utilisation of a large depression in the Western Desert between the Siwa oasis and the River Nile delta. According to the Cairo correspondent of the "Daily Telegraph," Dr. Ball, director of the Desert Survey Department, reports that a comprehensive survey last year confirmed the existence of an area of 4,500,000 acres, certain parts of which are as much as 134 metres (about 440 feet) below sea level. It is suggested that the most profitable way of utilising the depression would be for the generation of power hydro-electrically by means of water from the Mediterranean Sea. It would be necessary to construct a conduit to Qattara, 80 miles due south of Mersah Matruh, the fall thus obtainable being about 120 feet, and from the lake which would be formed some 4,000,000 cu. m. would be evaporated daily naturally if the depression were filled to a depth of 150 feet, thus obviating the need for drainage canals. It is estimated that a maximum of 300,000 h.-p., or 170,000 h.-p. at the most conservative estimate, could be generated, and the cost of the scheme is calculated as £15,000,000, with £1,000,000 annually for maintenance, but it is thought that it would bring in a revenue of £2,000,000 per year. The scheme might result in important climatic modifications over a large area of what is at present an utterly waterless desert.

Vosges Railways.—Less favoured than the Pyrenees and the Alps, where important railway undertakings are being completed, the Vosges are still waiting for the putting in hand of the three schemes which are to connect up the French railway system with Alsace-Lorraine by shorter routes through the mountain range. Immediately after the Armistice it was proposed to construct without delay three lines which would involve the tunnelling of the Vosges, but as the restored provinces are already served by the railways from Nancy to Strasburg and from Belfort to Mulhouse, it was deemed advisable, in view of the unsatisfactory financial situation, to let the schemes remain in abeyance for the time being, and work was continued on the line from Saint-Dié to Saales, which was regarded as being of a more urgent and less costly character. The length of the line is 15½ miles. From Saint-Dié it follows the Meurthe, which it crosses at Sainte-Marguerite, and then continuing up the valley of La Fave rises by easy gradients until it traverses the Vosges by a helicoidal tunnel 1,600 m. long. A large number of bridges, viaducts and short tunnels have had to be constructed. The line will be completely terminated during the present year. While railway communication with the restored provinces is being improved, there appears little hope of anything being done to meet the needs of Alsace in the way of electrifying the system. It was expected that some of the energy to be provided by the power stations on the proposed lateral canal would be available for the purpose, but, for reasons of national defence, it is understood that there will be no electrification of railways in the frontier province.

A Steam Shed Innovation.—According to the "Railway Gazette," one of the large American railways, the Grand Trunk Western, has recently installed at a steam shed within the limits of the city of Chicago what is referred to as "a direct steaming plant," which has resulted in the almost complete elimination of smoke, and has actually created a fireless engine house. The locomotives are supplied with steam from a stationary boiler plant through the medium of flexible connections at each engine stall. After leaving the cinder pit where the fires are dumped, the locomotive proceeds under its own steam to the engine house, where it is immediately connected to the power plant supply through an extra heavy flexible copper hose and a steam pipe line, which maintains the pressure at within a few pounds of that of the stationary plant. After boiler and firebox inspection, 90 shovelfuls of coal are distributed evenly over the grates. The steam pressure in the locomotive boiler is maintained at 150 lb. or more until the engine is required to go out into service. It then moves out of the shed under this pressure, and is fired up outside. It has been found from experiments that when the engines leave the shed with the pressure mentioned in the boilers they can be fired with but very slight trace of smoke. To determine the amount of coal required to fire up under ordinary conditions, a 2-8-2 type engine was fired by hand and the pressure held at approximately 150 lb. for 24 hours, the results indicating an average fuel consumption of 375 lb. of coal per hour. To handle the same type of locomotive with direct steam required 112·5 lb. of coal per hour, indicating a saving under the direct steaming system of about two-thirds of the locomotive fuel.

General Articles.

ELECTRIC LOCOMOTIVES FOR THE G. I. P. RAILWAY.

A Locomotive Developing 2,600 H.-P. for Freight Service and another of 2,160 H.-P. for High-Speed Passenger Service.

BY the courtesy of the builders, the Metropolitan-Vickers Electrical Co., Ltd., the "Railway Gazette," to whom we are indebted for the article and illustrations on the opposite page, are enabled to illustrate and describe two locomotives which constitute one of the most important recent developments in electric locomotive construction in this country. They are respectively for freight and passenger service on the main lines of the Great Indian Peninsula Railway, from Bombay to Igatpuri and to Poona, and have been erected and equipped to the specification of Messrs. Merz and McLellan, the consulting engineers for the scheme.

The freight locomotive is the largest and most powerful yet built in this country, and is the first of forty-one similar locomotives which are being supplied by the Metropolitan-Vickers Electrical Company under this contract. It is equipped with motors totalling 2,600 h.-p. and weighs over 120 tons, the whole of this being adhesive weight. The construction is articulated —the body, which is about 60 feet in length, being carried on two trucks which are coupled by a flexible joint. The rigid wheelbase is thus reduced to that of a single truck, *viz.*, about 16 feet, which enable sharp curves to be negotiated. Regenerative braking is provided to enable heavy trains to be safely handled on the heavy gradients. Operation is on a 1,500-volt supply from overhead line. The control system is electro-pneumatic. To eliminate all risk of accidental contact with high voltage parts all the high-tension apparatus is contained in a centre compartment the doors of which are locked so long as the apparatus is "alive." The mechanical parts for the first ten of these locomotives are being constructed by the Swiss Locomotive Works, of Winterthur, and those for the remaining thirty-one by the Vulcan Foundry Company, of Newton-le-Willows, Lancs.

The passenger locomotive presents many interesting features. It has three driving axles, one four-wheel bogie truck, and one two-wheel pony axle working in conjunction with the nearest driving axle so as to form virtually a four-wheel truck. The electrical equipment includes six 360 h.-p. motors and electro-pneumatic control. All high voltage parts are protectively enclosed as in the case of the freight locomotives. The mechanical parts have been supplied by the Swiss Locomotive Works. This locomotive will be used for high-speed service, and is mechanically safe for speeds up to 85 m. p. h. For speeds of this magnitude it is necessary that as little deadweight as possible should be carried on the axles, and for this purpose the motors and their gearing are rigidly mounted on the frame of the locomotive, and transmit their power to the driving axles through the universal motion flexible link drive, which is capable of accommodating the route of movement between axles and frame of the locomotive; all the weight is thus springbone, and the centre of gravity is comparatively high, so that the truck is thereby relieved from shocks. The total weight of the passenger locomotive is about 100 tons, 60 tons of which are available for adhesion.

It is the ultimate intention to operate the passenger locomotive, in conjunction with some of the freight locomotives mentioned, on the very heavy gradient section where the railway crosses the Ghats, and where average gradients of 1 in 40 are encountered over long distances. On these gradients a passenger train will be assisted by a freight locomotive operating as a banking engine, and the characteristics of the two locomotives are such that they will operate together with a proper sharing of the load.

It may be added that the last British records for weight and power of electric locomotives were also made by the Metropolitan-Vickers Electrical Company. The heaviest electric locomotive previously built in this country was the 110-ton high-speed passenger locomotive built for experimental work in connection with the proposed North Eastern Railway electrification, while the most powerful was the 2,340 h.-p. passenger locomotive recently supplied for the Paulista Railway of Brazil.

BRITISH ENGINEERING PROGRESS.

(BY A SPECIAL CORRESPONDENT.)

LONDON, *31st May 1928.*

AN IMPORTANT MISSION.

THE appointment of the four members of the Government Commission to confer with the Australian Commonwealth Government and leaders of industry and commerce on the development of Australian resources has attracted widespread attention, and, it is satisfactory to note, general approval. Where hostility to the proposal is expressed it is probable that the full scope of the Commission has been insufficiently realised, for, in addition to the subject already stated, it is empowered to examine other matters of mutual economic interest to Great Britain and the Commonwealth, which might tend to the promotion of trade between the two countries and the increase of settlement in Australia. It is appreciated that the composition of the mission represents a very wise choice and that the four members, Sir Hugo Hirst, Sir Harry McGowan, Sir Ernest Clark and Mr. Donald Malcolm are men of very wide experience and attainments.

The appointment of Sir Hugo Hirst is, of course, of particular interest to the electrical industry as he is chairman of the General Electric Co., employing over 20,000 people.

A BIG SWITCHGEAR INSTALLATION.

The G. E. C. is closely concerned with the supply of particularly interesting switch and control gear for the Nechells Power Station at Birmingham, one of the first large capacity power stations to be built in Britain. The complete contract includes 5,500-volt, 3-phase switchgear for installation in 50 moulded stonework cubicles, control boards for the electrical operation of the gear and all necessary accessories, all manufactured at the G. E. C. works at Witton. Control is provided for four of the five 22,500 k.v.a. G. E. C. Fraser and Chalmers turbo-alternators installed in the station and for 32 feeder circuits. The latter are divided into two groups, the first controlling trunk feeders which transmit power to sub-stations, and the second, ring and main feeders. Special rooms adjacent to the engine room are provided to accommodate the installation.

THE IMPORTANCE OF COMMUNICATIONS.

Judging by the picture now on view at the Royal Academy in London the bridge which Dorman Long and Co. are to build over the Limpopo River in Southern Rhodesia will be particularly pleasing to the eye. The proportions of the masonry in the piers and portals of the bridge appear to blend most happily with the actual steelwork, and the result is a good augury for the bridges of the future.

The Limpopo bridge will consist of fourteen spans, each of about 100 feet, which will be manufactured at Dorman Long's works at Middlesbrough in England and shipped to Rhodesia in sections for erection on the spot. The Limpopo river forms a natural boundary to the north of the Transvaal and the new bridge at Messina will mean a new link between Southern Rhodesia and the Union of South Africa

and will bring the former into direct communication with Delagoa Bay as an alternative port to Beira. The bridge will carry rail and roadway.

The Need for Better Roads.

Improved communications are called for wherever civilisation progresses and the cry for better roads was never so insistent as it is to-day. A system of road making which is being successfully employed in many parts of the Empire, as well as at home, is the Fowler Penetration system which results in a lasting roadway in the laying of which manual labour is cut down to a minimum. The necessary plant consists primarily of a steam roller on which is mounted a patented arrangement of tank, pumping gear and jets for delivering tar and bitumen mixture at high pressure on the road. The road metal to be consolidated is laid dry, the surface is then sprayed with some binding material such as a bitumen mixture, the pressure of delivery, over 200 lb. per square inch, ensuring that the road metal is fully penetrated and coated. A coating of smaller stone is then laid over the surface followed by a second application of binding material, and this is again repeated.

Hundreds of miles of roads have been constructed by this system in Great Britain in the last 10 years and have proved very satisfactory in use despite heavy lorry and 'bus traffic.

The Output of Chemical Plants.

The distillation of tar now forms a very important branch of the activities of the big by-product and chemical plants of the country. The Staveley Coal and Iron Co., for instance, deal with about 40,000 tons annually, some of it being sent from other coke-oven undertakings owing to the efficiency of the Staveley plant. Of the chemical products, priority of place must be given to sulphate of ammonia, the output of which is now over 5,000 tons per annum. A large proportion is sold for use in Great Britain and the remainder sent abroad.

Many of the Company's chemical products are not exactly by-products of the manufacture of coke but are rather commodities, the production of which was commenced to supply their own needs. Under this heading comes sulphuric acid, the output of which is upwards of 2,000 tons per month. Nowadays this acid, in one form or another, is used by numerous trades whether for electric batteries or artificial silk manufacture.

An Interesting Commemoration.

On 21st May 1879, at the engagement of Iquique, the Chilean wooden ship "Esmeralda" was sunk by the Peruvian monitor "Huascar," and it is said that the last gun on the Chilean vessel was fired by a midshipman named Riquelme just before she went down.

By a happy combination of circumstances the 49th anniversary of this occurrence was marked by the launching at Thornycroft's Southampton yard of the third of the six sea-going destroyers which are being built there for the Chilean Navy and the vessel was aptly named "Riquelme." The total cost of the six destroyers will be something like £1,750,000.

A Revolutionary Power Unit.

Such successful operation has attended the adoption of the Beardmore high-speed heavy oil engine for the propulsion of rail cars on the Canadian National Railways that it is being suggested that they should be applied to marine work.

Comparing the probable performance of this type of engine installed in a cross-channel vessel in place of single reduction geared turbines of about 9,000 s. h.-p. with 5 oil-fired water-tube boilers, it would appear that the actual fuel consumed on the voyage by the motor ship would be half of that of the steamer. Practically the whole of the boiler room space could be saved and so far as machinery weight is concerned, about 300 tons would be saved by adopting geared oil engines of the Beardmore type.

Combating Corrosion.

In spite of the great advance that has been made in the use of iron and steel it is interesting to observe that bronze which was one of the first metals to be of service to man is still of enormous importance. One reason for this is, of course, that bronze, or at least certain bronzes, offers a very high resistance to corrosion which the ferrous metals do not. To quote an actual example, a well known colliery company, with a view to adopting the most durable material for underground machinery, made comparative trials with wrought iron, steel and "Delta" bronze No. IV. Rolled bars of these three metals of exactly the same length and cross section were immersed for a period of 6½ months in the acid waters issuing from the pits. The loss of weight due to corrosion at the end of the period was 46·3 per cent. in the case of wrought iron, 45·45 per cent. with steel and 1·2 per cent. with "Delta" bronze. In another instance a piece of the same bronze weighing 4·468 oz. troy was immersed in a tank of salt water for six months and when taken out was found to be 4·461 oz.

As this bronze is also highly resistant to the corrosive action of foodstuffs, it is consequently extensively used in the construction of food-mixing and baking machinery and brewery plant.

How Modern Machinery Reduces Costs.

The discharge of dust and grit from factory chimneys has for a long time past been the subject of close investigation by eminent engineers particularly in thickly populated areas where such pollution of the atmosphere has a bad effect on health. There are, however, other aspects of the matter hardly less important.

In a paper mill situated in a country district, for instance, it was found that, unless the best quality coal costing *26s.* a ton was used, grit and dust from the chimney was apt to be blown into the buildings with serious effects on the quality of the paper with which it came into contact. The mill owner therefore investigated "Sirocco" mechanical boiler draught and found that it was possible by its use to burn cheaper coal satisfactorily and, further, by applying a Davidson flue dust collector the emission of dust was prevented.

After careful tests had been carried out it was found that, whereas formerly the mill consumed 70 tons per week of the high class coal at *26s.* a ton, with the "Sirocco" plant the consumption was 56 tons per week of coal costing only *16s.* a ton. Although the cheaper coal produced more dust, the collector removed it from the gases while the saving in the cost of fuel amounted to over £2,000 per annum. The plant paid for itself in 3 months.

Though in a totally different sphere it is perhaps permissible to cite another example of the way in which modern machinery, by reducing costs, is likely to develop widely the uses of a product. In the past the uses of Ramie fibre which is obtained from the stems of a plant closely allied to the stinging nettle, have been limited by the fact that no mechanical method of separating the fibre has proved successful, and it has been usual for hand scraping to be resorted to by the natives. This laborious and costly method has resulted in the production of relatively small quantities while at the same time the actual separation has frequently been inefficient.

The Leeds firm of Greenwood and Batley have, however, lately perfected a machine which will, it is confidently anticipated, mechanically decorticate the fibre in a much more efficient manner entailing no waste. Should this prove commercially successful, when used on a large scale, it should have a cheapening effect on the price of the fibre and an immediate result would be its employment for many other purposes than those at present in existence, notably for

damasks in competition with linen. At present the main uses to which Ramie fibre is put are for gas mantle yarns, tyre cord yarns, shoe-welting threads and such like, but it undoubtedly possesses far wider possibilities as it is much stronger than any other known fibre and has a lustre almost equal to silk.

A BRIDGE IN THE ROYAL ACADEMY.

THE NEW LINK BETWEEN RHODESIA AND THE TRANSVAAL.

A PICTURE in this year's Royal Academy, which is of particular interest to constructional engineers, is that depicting the new road and railway bridge to be built over the Limpopo River in Southern Rhodesia, the contract for which has been secured by Dorman, Long and Company.

The bridge, which is being presented by the Beit railway trustees, will link Southern Rhodesia with the Union of South Africa, and will bring the colony into direct communication with Delagoa Bay. The consulting engineer for the bridge is Mr. Ralph Freeman, M. Inst. C. E., and the architects are Sir John Burnet and Partners, of London.

The bridge will consist of 14 spans each of about 100 feet, which will be manufactured in England and shipped to Rhodesia in sections, and as the Academy picture makes evident there has been a very happy blending of the work of the architect in the dignified proportions of the masonry piers and portals with that of the engineer in the steelwork.

The Continent of Africa already possesses outstanding examples of Dorman, Long's bridge construction at Dessouk over the Nile, about 40 miles from Alexandria, and again at Khartoum over the White Nile.

When tenders were asked for the Dessouk Bridge the time required for completion by certain Continental firms was $2\frac{1}{2}$ to 3 years, but Dorman, Long were awarded the contract, and carried out the whole work in a little over 13 months, including the demolition of an earlier bridge that had proved unable to carry the much heavier rolling stock in use to-day, and the erection of the new bridge, despite the fact that during seven months of the period the coal strike was in progress. The bridge consists of 10 spans with a total length of 2,010 feet, and was designed for the heaviest rolling stock which is likely to be used in the future by the Egyptian State Railways. A hand-operated swing span of 194 feet 6 inches permits the passage of river traffic. The total weight of the steelwork and other metal parts used in the construction amounted to approximately 3,800 tons, all of which was manufactured at the Middlesbrough works.

The Egyptian Minister of Transport stated that by the rapid completion of the Dessouk Bridge it was estimated that a saving of £E30,000 was effected to the Egyptian State Railways.

The Khartoum Bridge over the White Nile, which was opened by Sir John Maffey, Governor-General of the Sudan, early this year, forms part of a comprehensive scheme of improvement and extensions in the local public utility services, but it is of extreme importance in itself as hitherto the only connection between Khartoum and Omdurman was by ferry. Omdurman, besides having a population of nearly 80,000, boasts the largest agricultural market in Northern Africa.

The bridge, which was designed, manufactured and erected by Dorman, Long and Co., consists of seven fixed spans of 244 feet, and an electrically-operated swing span of 304 feet, which gives two clear openings of 100 feet each for the passage of river craft. The weight of the steelwork in the bridge was 3,136 tons. The bridge carries a 28 feet roadway with a single line of track for the electric tramway.

It is noteworthy that here also the contractors completed the work well ahead of time, no less, in fact, than five and a half months in advance of the contract date.

THE CHEMICAL PROPERTIES OF CRYSTALS.*

BY PROFESSOR CECIL H. DESCH, D.Sc., Ph.D., F. R. S.

(Concluded from page 336.)

IF we return to the simplest case of etch figures, that of cubic or octahedral pits on the surface of a pure metal crystallising in the regular system, we still find certain peculiarities which deserve attention. Granted that the attack follows definite lines or planes, why should the pattern recur at regular intervals, which are many thousands of times greater than the interatomic distances? Each etch figure starts from a point. It is impossible to attribute the origin to impurities or, as has sometimes been done, to convection currents in the liquid. A crystal of rock salt will develop perfect figures in a damp atmosphere, and it was shown fifty years ago that if a crystal of alum be allowed to grow under the microscope, and growth be interrupted by diluting the solution slightly, the distribution of the etch figures is quite similar to that on a crystal which has been exposed to the air. A well-formed crystal of quartz, etched with hydrofluoric acid, shows distinct etch figures widely separated from one another. These effects are not easily explained. They may be compared with the production of slip lines in the deformation of a crystal of a metal or a salt. The slip planes in a crystal, following the direction of the most closely packed planes in the lattice, are separated from one another by distances which are very large multiples of the interatomic distance. Why, out of such a large number of similar planes, should so few be concerned either in slip or in chemical attack? A basis of explanation has been suggested by Finlayson in the Faraday Society discussion on cohesion. Atoms in the same space lattice are oscillating, not at the same frequency, but with a range of frequencies from zero up to a maximum, and the theory of probability would suggest the occurrence of waves at intervals which would vary with the temperature and the applied stress. The suggestion is a promising one, and a similar explanation may be applicable to the formation of etch figures.

Leaving the exterior of the crystal for the present, we may consider the arrangement of the atoms in the interior when they are of more than one kind, as in solid solutions and in intermetallic compounds. The effect of foreign atoms in solution in distorting the space lattice and thereby hindering slip, so increasing the hardness, has been dealt with very fully by recent writers. Foreign atoms may enter into a solid solution in more than one way. They may replace the atoms of the original metal one by one, causing comparatively little change in the lattice. This is most likely to occur when the two kinds of atoms are similar in chemical character and also in volume, as in the pair gold and silver, which can form a continuous series of solid solutions, the space lattice, changing its dimensions to a small extent without any profound alteration in its character. It is a controversial question whether such solid solutions tend to arrange themselves so that the distribution of the second species of atoms in the lattice is a symmetrical one.

Another type of solid solution is that in which relatively small atoms are packed into the interstices of the lattice, without very greatly altering its dimensions. This is supposed to be the case in austenite in steels, the carbon atoms being packed into the γ-iron lattice without causing much expansion, and without altering its symmetry.

Changes may occur during the cooling down of a solid solution of either of these types. The capacity of the space lattice for holding the second kind of atoms may diminish, so that a constituent is thrown out from solution, just as when a liquid solution has

* Eighteenth May Lecture to the Institute of Metals, delivered 8th May 1928. Abridged. From the "Engineer."

become supersaturated. In such a process, the varying properties of different planes within the crystal must again make themselves felt. Deposition will not take place uniformly throughout the crystal, but preferentially along certain planes, which are as a rule the most densely packed planes.

When metallic atoms are associated in the form of a solid solution, we may suppose that the constitution is essentially the same as that of a pure metal, metallic irons and free electrons forming a stable system with metallic conductivity, but without the properties of an electrolyte. The more closely similar the metals are, the less will the properties of the solution diverge from those of a single metal. As the properties become more dissimilar, chemical affinities become more important, until we pass through a succession of intermediate stages to such compounds as the metallic sulphides, which have ionic lattices and yet retain certain characteristics of the metallic state, such as electrical conductivity. The nitrides and carbides, which occupy an intermediate position, are supposed by some to be ionised, and by others to consist of atoms, without any distinct association into separate molecules. Attempts are being made in several quarters to distinguish by X-ray methods between ionic and atomic lattices, but there are still differences of opinion as to the interpretation of the results. There is no doubt that such discrimination is possible, but the matter is not yet ripe for a full discussion. So far, the X-ray evidence has not shown the presence of distinct molecules in alloys containing even well-defined intermetallic compounds, and so far it might be said that the compounds were built up of ions rather than of atoms united by covalent links, but it will be well not to dogmatise on this point. In all probability, there are gradations between true compounds and solid solutions.

The chemical properties of a compound or a solid solution will depend to a large extent on the closeness of packing. Although close packing is most familiar to metallurgists through recent work on metals, it is by no means invariable in crystals, and a special interest attaches to substances which are known to have comparatively open packing. Reagents can penetrate into an open-packed lattice with ease. An excellent example is that of graphite.

The mechanism of diffusion in solids has become more difficult to interpret since the information given by the X-ray method has been available. It was formerly possible to regard it as a simple change of place between neighbouring atoms, so that a foreign atom entering a space lattice could traverse it by a succession of single steps. As equilibrium in a solid solution would only be reached when the concentration had become uniform throughout, the force bringing about diffusion was regarded as osmotic pressure, and the laws of diffusion in liquids were applied to the case of solids. It proves, however, that in the ordinary space lattice there is not room for the change of place of neighbouring atoms, unless perhaps at temperatures approaching the melting point, when the amplitude of oscillation is large. And yet it is impossible for such reactions as the age-hardening of aluminium alloys by the deposition of particles from solution, or the separation of α crystals from a 60 : 40 brass on cooling, to take place without the transport of atoms through a space of many thousand atomic distances. Diffusion in crystals is an undoubted fact, although it does not always occur when a difference of concentration is present. Minerals which show a zoned structure, the equivalent of coring in alloys, have existed in rocks for millions of years without change, although the condition of equilibrium would presumably be one of uniform distribution throughout the mineral. Neither has diffusion been brought about in such minerals by artificial annealing. On the other hand, the halogen salts which are isomorphous may be made to diffuse into one another by heating a mixture of the powdered salts, and von Hevesy has found that silver iodide and cuprous iodide will interdiffuse to a depth of several millimetres in a few hours at 480 degrees. As to diffusion in metals, there is an abundance of evidence, beginning with the striking experiments of Sir William Roberts-Austen on the diffusion of gold into lead, the accuracy of which has been confirmed by later workers. The law of diffusion is approximately fulfilled, and the process continues until the solid solution is saturated. It is remarkable, however, that experiments of this kind mostly fail when tried with a specimen consisting of a single crystal, and the process is more rapid in a fine-grained metal than in one of the same composition but of coarser grains.

Loosening of texture may be of importance for the chemical properties of crystals, even part from diffusion. It has long been known that a crystal of a hydrated salt may remain unaltered in dry air so long as the surface is perfect, but that a scratch will at once allow efflorescence to begin.

There are also reactions which consist in the passing out of atoms or molecules from the crystal, such as the liberation of oxygen by the heating of solid potassium permanganate. This has been observed to be essentially a boundary effect, and to be accompanied by a breaking down of the crystals—that is, the formation of new boundaries. The crystal itself is too closely packed to allow of the passage of oxygen outwards by simple diffusion.

To sum up. The chemical properties of crystals are, like their cohesion and their electrical conductivity, intimately bound up with the character of their space lattice. Since, moreover, it is the outer or valency electrons which are concerned in chemical reactions, the behaviour of the atom in the solid state is likely to be profoundly modified by its geometrical relations to its neighbours, on account of the deformation of the electron orbits. Looseness of packing is an important modifying factor, and it may be easiest to follow chemical processes in solids by observations on crystals having a more or less open structure, proceeding from them to the more perfect metallic and ionised types. The Bohr conception of the atom, and the perfected X-ray technique which is now coming into use, are the two means by which a solution may be reached of problems which have a high interest for practical as well as for theoretical metallurgy.

CARNEGIE INSTITUTE OF TECHNOLOGY.

BETWEEN 60 and 70 scientists and fuel technologists in eleven different countries, it is announced, have tentatively accepted invitations to either speak or to read papers at the Second International Conference on Bituminous Coal which will be held at the Carnegie Institute of Technology in Pittsburgh, Pa., during the week of 19th November 1928. The list includes about forty Europeans whom Dr. Thomas S. Baker, president of Carnegie Institute of Technology, personally invited while making his recent two-months' visit in Europe in the interests of the coal conference.

The purpose of the coming congress, an announcement points out, is similar to the one held in 1926 by the Carnegie Institute of Technology: to present the results of recent studies of coal that have to do with improved methods of utilization and combustion. The programme will include the discussion of low temperature distillation, high temperature distillation, coal tar products, power, smokeless fuel, complete gasification of coal, hydrogenation, pulverized fuel and its new applications, fixation of nitrogen, coal beneficiation, etc.

Upon his return from Europe in April, President Baker expressed the opinion that the second conference will be much larger in scope and importance

than the first, and that the number of delegates from foreign countries will be considerably in excess of that at the 1926 meeting when thirteen different nations were represented.

Tentative acceptances have been received from the following scientists who will either be present or will contribute papers at the congress :

ENGLAND.

William A. Bone, Professor, Imperial College of Science and Technology ; Edgar C. Evans, National Federation of Iron and Steel Manufacturers ; H. A. Humphrey, Imperial Chemical Industries, Limited ; Dr. Cecil H. Lander, Director of Fuel Research, Department of Scientific and Industrial Research ; Dr. R. Lessing, Consulting Engineer ; The Right Honourable Sir Alfred Mond ; Harald Nielsen, Sensible Heat Distillation Limited ; Dr. E. W. Smith, Technical Director, The Woodall-Duckham Companies ; F. S. Sinnatt, Assistant Director of Fuel Research, Department of Scientific and Industrial Research.

FRANCE.

Donat Agache, Président du Conseil d'Administration, and Raymond Berr, Director Général, Etablissements Kuhlmann ; Jean Bing, Comité Central des Producteurs et Distillateurs de Goudron en France ; Ch. Emile Hourteau, Compagnie des Mines de Houille de Marles ; Andre Kling, Directeur du Laboratoire, Municipal de la Ville de Paris ; Henri Lafond, Compagnie Internationale pour la Fabrication des Essences et Pétroles ; Paul Lebeau, Professor, University of Paris ; A. Mailhe, Professor, Etude des Combustibles, Faculté des Sciences à la Sorbonne ; C. Simon, l'Administrateur Délégué, Société pour l'Exposition des Tubes Electro-Frettés ; Paul Weiss and Henri Winckler, Compagnie des Mines de Vicoigne.

GERMANY.

Rudolf Battig, General Director, The Mont-Cenis Process for the Fixation of Nitrogen ; Dr. Friedrich Bergius ; Dr. L. Edeleanu ; Professor Doctor Franz Fischer, Kaiser Wilhelm Institut für Kohlenforschung ; Dr. Ing. I. P. Goosens, Messrs. Gossens, Lochner and Co. ; Dr. A. Herz, Kohlenveredlung A. G. ; Professor Fritz Hofmann, Schlesisches Kohlenforschungsinstitut der Kaiser Wilhelm Gesellschaft ; Professor P. P. Kerschbaum, Metallbank und Metallurgische Gesellschaft ; Dr. Carl Krauch, Director I. G. Farbenindustrie ; Dr. Friedrich Munzinger, Allgemaine Elektricitats Gesellschaft ; Dr. J. E. Noeggerath ; Rudolph Pawlikowski, "Kosmos" Maschinenbauanstalt ; Joseph Plassmann, Director, Chemisch-Technische Gesellschaft ; Dr. Alfred Pott, A. G. fur Kohlenverwertung ; Dr. Ing. P. Rosin ; Professor Ernest Terres, Technische Hochschule, Braunschweig.

ITALY.

Commendatore Alberto Edoardo Bianchi, Director, Fabrica Coloranti Bianchi ; Engineer Guardabassi, Fabrica Coloranti Bianchi.

AUSTRIA.

Professor Dr. Fleissner, Montanistische Hochschule, Leoben.

DENMARK.

Professor P. E. Raaschou, Laboratoriet for Almen Teknisk Kemi den Polytekniske Laereanstalt, Copenhagen.

BELGIUM.

A. France, Compagnie Internationale des Rheolaveurs, Liege ; and a representative of the Semit-Solvay Company.

RUSSIA.

Professor L. K. Ramsin, Director of the Thermotechnical Institut, Leninskaya Sloboda ; George L. Stadnikoff, Karpov Institut, Moscow.

JAPAN.

Professor Yoskikiyo Oshima, Tokio Imperial University ; Dr. Chozo Twasaki, Tohoku Imperial University.

UNITED STATES OF AMERICA.

H. A. Brassert, Consulting Engineer, Chicago ; Professor A. G. Christie, Johns Hopkins University ; Professor Harry A. Curtis, Yale University ; W. A. Darrah, President, Continental Industrial Engineers ; Howard N. Eavenson, Consulting Engineer, Pittsburgh ; Gustav Egloff, Universal Oil Products Company, Chicago ; F. C. Green, Old Ben Coal Corporation, Chicago ; Professor E. C. Jeffrey, Harvard University ; Louis C. Jones, President, Nitrogen Engineering Corporation ; C. F. Kettering, General Motors Corporation ; Dr. Arthur D. Little, Consulting Engineer, Boston ; Dr. H. C. Parmelee, Editor of "Chemical and Metallurgical Engineering" ; Professor S. W. Parr, University of Illinois, and President, American Chemical Society ; Dr. F. W. Sperr, Koppers Company, Pittsburgh ; Professor Hugh S. Taylor, Princeton University ; Dr. R. Thiessen, Bureau of Mines, Pittsburgh ; F. G. Tryon, Bureau of Mines, Washington, D. C. ; Professor Alfred H. White, University of Michigan.

CANADA.

A. T. Stuart, Consulting Engineer, Toronto.

The governments of Spain and of Czecho-Slovakia, it is announced, are also expected to send representatives from their respective Departments of Mines.

Professor Sumner B. Ely, of the Carnegie Institute of Technology, is Secretary of the Second International Conference on Bituminous Coal. The Advisory Board of the Conference includes the following American men of Affairs : John Hays Hammond, E. M. Herr, Samuel Insull, Frank B. Jewett, Otto H. Kahn, George E. Learnard, Hon. A. W. Mellon, Auguste G. Pratt, and Charles M. Schwab.

The Gazettes.

Bihar and Orissa, June 13, 1928.

Irrigation Department.

Mr. Desraj Mehta, Assistant Executive Engineer, is granted leave on average pay for one month and one day with effect from 13th March 1928.

Mr. Desraj Mehta, Assistant Executive Engineer, is, on return from leave, reposted to the Dehri Division.

Punjab, June 15, 1928.

Irrigation Branch.

Mr. N. G. Watson, Temporary Engineer, attached to the Public Works Department, Punjab Irrigation Branch, is allowed by the High Commissioner for India 2 months' leave on half average pay and 2 months' leave on quarter average pay on medical certificate in extension of the leave granted to him previously.

The following officers of the Public works Department, Punjab, Irrigation Branch, passed the Departmental Revenue Examination prescribed in Article 13 of the Irrigation Manual of Orders on 17th April 1928 :—

Mr. T. Burtt, Executive Engineer, Lower Jhelum Circle ; S. Mohammad Abdul Hamid, Assistant Executive Engineer, 2nd Bahawalpur Circle ; Lala Kanwar Sain, Assistant Executive Engineer, 3rd Bahawalpur Circle ; Lala Ram Prasad Barman, Assistant Executive Engineer, Lower Chenab East Circle ; Mr. A. E. Baptist, Assistant Engineer, Lower Jhelum Circle ; Mr. F. G. Beck, Temporary Engineer, Western Jumna Canal Circle ; Lala Din Dayal Mehta, State Subdivisional Officer, 1st Bahawalpur Circle.

Lala Nand Gopal, Assistant Executive Engineer, who is fully qualified for the charge of a division, is promoted to executive rank with effect from 1st October 1927.

Mr. J. W. Smythe, Assistant Engineer, on transfer from the Montgomery Division, Lower Bari Doab Canal, which he left on 15th May 1928, joined the Balloki Division, Lower Bari Doab Canal, on the 16th idem, and took over charge of that Division on the same date, from Rai Sahib Lala Gian Chand, Assistant Engineer, who proceeded on leave.

Mian Mohammad Said, Temporary Engineer, on transfer from the Jandiala Division, Upper Bari Doab Canal, joined the Karnal Division, Western Jumna Canal, on 15th May 1928, on return from leave.

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INDIAN ENGINEERING.

SATURDAY, JUNE 30, 1928.

MR. SYDNEY M. JACOB.

III.

IN our last chapter, some indication was given of the sort of scientific work that was done by Mr. Jacob in his spare time and outside of the ordinary duties of the appointments he had held. But at the end of 1918, he was transferred to officiate as Director of Agriculture, Panjab, in the absence of the permanent incumbent of the post, and had therefore more opportunities of scientific research with a direct bearing on the duties of his office. He found also that one of the Deputy-Directors of Agriculture, Mr. O. T. Faulkner, was a man after his own heart. Mr. Faulkner had a true scientific outlook, and, in particular, he was appreciative of the value of "probable error" tests in sifting the evidence afforded by crop experiments. He had done a good deal of work in determining the "standard deviation" of the yield of different crops at the Lyallpur Experimental Station for fields of various sizes and shapes and on the reduction of the "standard deviation" for correlated pairs of adjacent fields. The two officers were engaged in the preparation of a joint-paper on the subject for submission to the "Journal of Agricultural Science," when Mr. Faulkner left India on securing the appointment of Director of Agriculture, Nigeria. The collaboration therefore ceased and it was unfortunate, for, although Mr. Faulkner subsequently completed the paper by himself and it was published in the "Agricultural Journal of India," the novel portion of the research was omitted, namely, the diminution of the "coefficient of variation" with increasing crop yields.

Mr. Jacob also worked with Mr. Faulkner at a test of Gibbs' module under varying conditions of up-stream and down-stream levels. Mr. Gibbs of the Panjab Irrigation had invented what was considered to be one of the best types of modules on the market, and the value to the Agricultural Department of an instrument which would give a known constant discharge of water unaffected by variations of supply and down-stream levels was obviously very great, especially in all experiments dealing with water-cost and optimum moisture conditions. This work was also interrupted by Mr. Faulkner's departure from the Panjab, but it was continued by Mr. H. R. Stewart who succeeded Mr. Faulkner as Deputy-Director. The first series of tests were carried out by Mr. Faulkner in 1920 on the earlier Gibbs' module, and the second series by Mr. Stewart on the "improved" type of the same module. The modules were erected with care in accordance with the instructions supplied by the patentee under the supervision of Mr. Miller Brownlie, Agricultural Engineer, Lyallpur, and Mr. Jacob, who was present at some of the tests of both series, took a considerable amount of trouble in collating the results and in smoothing the data. It is understood, however, that the paper, dealing with the conclusions arrived at,

which would be of much interest to the Irrigation, as well as to the Agricultural, Department, was not published. The subject of modules is a very important one to a great irrigation province like the Panjab. The late Mr. R. G. Kennedy, whose invention was the first in the field, had originally in his mind the possibility of a device which would enable the water rates of canals to be based on volume of water used instead of on acreage and classes of crops irrigated. It was a great aim; it is common knowledge that the acreage rate practice is subversive of economy in consumption; it means that whether the waterings are many or few, heavy or light, the charge is the same, and that there may be injurious waste. The volumetric system is the best means of preventing over-irrigation by appealing automatically to the pockets of the cultivators. But even assuming that the practical difficulties of such a system are insurmountable, modules have their value in introducing a better method of distributing water by area than that which used to obtain. It would have been very useful to have had the opinion of a scientific observer, like Mr. Jacob, on the Kennedy, Gibbs, Harvey-Stoddart and Crump types, and at any rate it is hoped that his paper on the tests made with the Gibbs' module may yet see the light.

Aerial crop-survey was another matter which attracted Mr. Jacob's attention. Early in 1919 he had met Captain H. H. Thomas, who had been Aerial Reconnaissance Officer with the Palestine Expeditionary Force, and had been impressed by the beautiful photographs taken by him. At that time the British Government was proposing to present to the Government of India a hundred service 'planes, and six of these were promised to Mr. Jacob for an experimental crop-survey, a line of work he had begun at Lahore with the aid of the Air Squadron stationed there. A number of photographs of growing *rabi* crops had been taken from heights of 3,300 to 12,500 feet with a view to determining the most suitable height for accurate identification of crops. These preliminary tests seemed to indicate that a height of about 6,000 feet (a 10-inch lens on a 5″×4″ plate at this altitude enclosing an area of approximately a quarter of a square mile) would be satisfactory, if means could be devised to distinguish wheat, gram and seuji, the principal crops growing in northern India at that time of year. Sugar-cane, then at its full growth, was found to be distinguishable up to 10,500 feet. The possibility of using coloured screens, and thereby identifying crops only just at the tillering stage, was considered; but the budget funds allotted for the purpose were withdrawn for what was held to be more important, and the experiments had to be abandoned.

At the close of 1921, Mr. Jacob was placed on special duty for a statistical enquiry into the fluctuation of crop prices, and no doubt the prospect was much to his liking as he would have felt that he could devote himself to a special study without the handicap of disturbance by routine work. But he was doomed to disappointment, in a few months he was re-appointed Director of Agriculture, and a little later was ordered to take charge of census operations. The preliminary results of the enquiry into prices were printed in a paper read before the Indian Economic Association in 1923, and in the paper the annual fluctuation of prices was expressed in terms of harmonic functions, while periodogram analysis was applied to the fortnightly Gazette prices from 1875 to 1921, and a theorem was propounded which connected the intervals between successive peaks in prices. As the author wrote the paper with his census work in full swing, he could not give his undivided attention to it, and there were doubtless good grounds for the criticism of the Royal Statistical Society, whose attitude was otherwise favourable, that the third section of the paper should be rewritten. The result, indicating as it does, the inertia of prices intending to maintain an upward or a downward tendency is not unnaturally regarded as either trivial or obscure; yet the agreement of the observed intervals of time elapsing between price maxima with the curve indicated by theory suggests that the theory has at least a germ of vitality.

Even in his census work, Mr. Jacob showed a mathematical bent of mind unusual in work of this nature, and his task in writing the Panjab Report was probably not the easier by reason of his natural distrust of ordinary statistical conclusions. Statistics is an art which is not as plain-sailing as the man-in-the-street supposes it to be, and the so-called common-sense reasoning has many dangers. Indeed, so numerous and disguised are the pitfalls which lie in the path of the wanderer in the number-forests of economics and sociology that statistics might almost be defined as the art of avoiding numerical inference. One of the chief pitfalls brought to notice in the Census Report by Mr. Jacob was the error in reasoning based on variations of the proportion of "foreign-born" in any area, which, as he showed, proved little except that the Panjab administrative districts vary in size. He also exposed the fallacy, well known to professional statisticians, of the "uncorrected" death-rate, and showed, contrary to the usual official claims, that the mortality in Panjab jails was greater and not less than that of the outside population. Other, rather more synthetic, ideas were developed in discussing fertility, cousin-marriage, and the relationship of consanguinity to disease. The Superintendentship of the Census Operations of 1922-23 was Mr. Jacob's last appointment in India, he took leave on the completion of this work, and retired in 1924.

In 1924 he was forty-five years of age and, physically and mentally, in vigorous health. Eager as he had always been for the kind of work for which he possessed special qualifications, he was not the pedant-in-a-library sort of man and was anything but physically lethargic. He excelled particularly in lawn-tennis, and with more opportunities in his younger days would doubtless have had still greater successes than those that fell to him. In the hands of the great exponents of the game, tennis has now reached such a pitch of excellence that no one can possibly arrive at first-rate form without constant practice in the best of company, and the afternoon "pat-ball" of small Indian

stations gives no scope for any high degree of proficiency. Mr. Jacob was nevertheless Captain of the All-India Davis Cup Team in the years 1921 to 1925; in India, among other events, he was the winner of tournaments at Delhi, Allahabad, Simla (Viceroy's Cup), and Lahore (Chamba Cup); in England he won the West of England Championship in 1921, the East of England and North of England Championships in 1923, the South of England mixed doubles in 1921 and 1923, the Covered Court Championship of 1925, and the London Covered Court Championship of 1927. The two last of the abovementioned contests are important affairs, they are open to the world, and the former of the two has been termed the World's Covered Court Championship. It was won by one of the best world's players, M. Barotra of France, in 1926, a year in which Mr. Jacob did not compete. This record of successes has, it is believed, never been equalled by any other lawn-tennis player from India. Nor, in the years subsequent to his retirement from the Indian Civil Service, has he neglected scientific work. In association with Mr. J. H. Field, late Director-General of Meteorology in India, he has taken out two patents, written various mathematical papers, and it is understood that there is some question of his appointment as Government Statistician in Nigeria.

(To be continued.)

THE INDUSTRIAL ARTS.*

MR. FREDERICK J. GLASS, Head Master of the School of Arts and Crafts, Doncaster, has written a number of books in relation to craftwork, and he has always had in view the importance of stimulating interest in the subjects concerned as educational factors. He holds that the combination of hand and brain, of motor with mental activity, is calculated to produce better results than when the brain alone is exercised, and he therefore aims at bringing the industrial arts into their proper place in the educational system. The aim seems to be commendable, from prehistoric times the progress of the human race in the direction of civilisation has been largely dependent on art and craft work, in that progress the craftsman has been invaluable, and apart from necessities the æsthetic element is not an unimportant factor in any scheme of education. If fitness is the main object, beauty in connexion with it may be regarded as indispensable in all creative work. The craftsman has never had his full due, a man who dirties his hands with honest toil has been looked upon as an inferior being compared with the man whose occupation demands that he should be clean. It is a wrong estimate of the dignity of labour. It is a problem whether the rapid march of machinery in the world is a blessing, but the joy experienced by the artist in the work of his hands is without a drawback except for those who clamour for shorter hours and more pay. The creative work of the true craftsman is a pleasure to him from the nature of his outturn, he is not a man in a factory who can punch eyelet holes but cannot make a boot, or who can cut strips of wood but cannot make a table. Man is a tool-using animal, as Carlyle said, and he once used his tools for making a complete article, but if modern machines are only improved tools which can be traced back to a simple origin, it was after all the tools of the old craftsmen which led up to them. Mr. Glass has done good service by the way he puts his case, in any walk of life the form of education he advocates is worth while, and it may perhaps have some special value for engineers and architects in teaching them to appreciate the characteristic qualities of materials. The more we understand these things, the better will our craftsmen be from the very fact that an intelligent interest is taken in their operations; and the Indian craftsman is worth encouragement, he has great inherent skill, and with more appreciation of his efforts he is capable of rising to higher levels.

The book begins with Shelters, which may be said to be the foundation of architecture. Architecture is the first of the arts, for man had in the earliest days to shelter himself against the elements and beasts of prey. Caves afforded that sort of protection, but caves were not always available, nor in any case were they sufficient for the increasing need for accommodation. So the primitive shelters in the hands of craftsmen improved out of all recognition, then came the glories of Greece and other ancient civilisations, the great Renaissance and beyond. There was a thirst for colour and colour came; and furnishings which afford interesting history; and fabrics for clothing and adornment; leather work, metal work and jewellery; tools of all kinds; paper and books; pottery, china and glass; vehicles for transport, boats and the rest. The author runs through the whole gamut of the contributions of the craftsman to the needs of mankind, and makes it all very fascinating reading. We cannot help being interested, the items affect human life in all its bearings, and the information given, besides showing how much the craftsmen have done for us, is a form of education we should not ignore.

* The Industrial Arts: Their History, Development, and Practice as Educational Factors. By Frederick J. Glass, Author of "Design and Composition in Line, Form and Mass," "Drawing, Design, and Craftwork," etc. London: University of London Press, Ltd., Warwick Lane, E. C. 4.

WILLCOCKS ON THE MISSISSIPPI.

THE problem of the Mississippi is no very recent thing, but we happen to have only now received the Proceedings of The Engineers' Society of Western Pennsylvania of 1914, containing the paper on "How the Ancients would have controlled the Mississippi and its Tributaries," contributed to the Society by Sir William Willcocks, who has always had a wholesome respect for the wise men of old, and not without reason. As it has been said, no matter whence we quote, knowledge grows from the accumulation of information, but for the last few thousand years there has been no growth of the human intellect. The Romans have not been beaten at government; no one has expressed passion better than Sappho or form better than Phidias; there have not been more

scientific physicians than Hippocrates or Galen; we cannot map the world more philosophically than Aristotle, nor is there more dialectical facility than that of Plato. All that we have is a vaster mass of tradition. In the old days, too, there were despotic kings, and if men failed in their duties they suffered to encourage the rest.

Engineers know pretty well why Mississippi disasters have occurred, the river was deprived of elbow room, and rivers of that kind want room for floods. To contract them within walls is to court calamity. In that respect, Sir William Willcocks said, Nature has a law. She is careless of a single life and careful of the type, but in the Mississippi valley the action has been to be careful of the single life and careless of the type, so that unless there is a return to Nature's law there can be no permanent improvement. The Mississippi is a big river, four times the size of the Nile, seven times the size of the Tigris, twelve times the size of the Euphrates. But, Sir William said, size in these questions has nothing to do with difficulty. Indeed, the bigger the problem the more clearly its difficulties can be seen; and the lecturer brought that point home by adding: "I am sure that there is not a single married man among us who does not know that Solomon with his three hundred wives had a much easier problem than any of us has with his one wife." The Mississippi has a length of 1,000 miles, in a straight line 550 miles, and there are 1,540 miles of levees along its banks. The width of the valley is about 50 miles, and in the valley the natural reservoirs or basins cover a large area. The area of these reservoirs down to the Red River is 12,500,000 acres, and downstream of the Red River there are 6,500,000 more acres, altogether 19,000,000 acres of natural reservoirs. Allowing six feet of water above the natural bank of the river, which is what happened in the flood of 1882, the natural basins in the valley represent about 12,500,000 acres, eight feet deep, or 100,000,000 acre feet, a vast safety valve. The ancients would have regarded these reservoirs as a great asset and would never have allowed them to be cut off from inundation by levees, until at any rate they were sure that all the lands below were well protected. Modern America acted on the principle that it was a pity to allow any land not to be protected by a levee and left open to the floods, and thereby led to a position of very serious gravity. Moreover, out of the 12,500,000 acres in the upper valley there are only 4,000,000 acres cultivated to-day, the rest is still primeval forest, and, Sir William said, to throw up levees to drown out the people below for the sake of protecting a large area of forest is doing the country harm rather than good. If water were allowed to flow over this land, it would be fertilised by the silt and so much improved that the people whose land lay outside the levees would possibly find themselves better off than the owners of the land inside. In two years out of three they would get first class crops on the unprotected and, and even in bad years a half crop if they wished. This is only putting the matter in its broad aspect very briefly, and Sir William Willcocks in his address explained in detail and at much greater length what the ancients would have done and gave his own advice as to future action, with the warning that "the conditions on the lower Mississippi are very serious, and delay may produce a flood which may be not unlike Noah's flood, some day."

That the ancients were no fools we are all very well aware; and, as Sir William remarked, they were always very much in earnest with their rivers, far more so than people are now. But there was more reason for their earnestness and a greater incentive to be wise. In Egypt and ancient Babylonia, there could be no cultivation except on land irrigated by rivers or inundated by them, they were not countries of temperate climate and sufficient rainfall for crops. Nor when calamity occurred had the people behind them a government like that of America with the wealth and the intentions to relieve distress whenever it occurred. And there was yet another incentive to wisdom, the fear of punishment. Any ill-success on the part of the engineers of old was enough to make them tremble. Sir William Willcocks asked his audience to imagine the Senators and Representatives in Washington sitting down quietly and looking academically at the question of the Mississippi River if the Capital itself were located behind a levee liable to breach in flood; or to imagine the Commission which looks after the Mississippi levees dwelling in a position of danger instead of at a place where there is no sort of risk. In Babylonia they would have been made to live behind the most dangerous levee, and then, whatever else they did, they would take care that there were no breaches. The calamity of the Mississippi of 1912 did not make them quake in their shoes; but in the seventh century of our era, when a serious breach occurred in a Tigris levee, the king caused four hundred engineers and supervisors to be thrown into the breach. In 1887, on the occasion of a high flood on the Nile, Sir William said that he saw a white-haired man working very energetically, and he said to him, "I have never seen an old man as energetic as you are." The man replied, "I am not old, only my hair is white." "How did it become white." Then he said, "I had charge of the Nile bank in the great breach of 1878, and the Khedive telegraphed that the engineer was to be thrown into the breach. I was the engineer, but though I was reprieved through the intercession of my family and friends, my hair had turned white." Sir William has a way of arresting the attention of his audience with stories and phrases which bite into their topic, and that is why he is always listened to. But there is no longer that form of stimulus to good work, our engineers may bungle ever so badly and they are not cast into our great Indian streams, nor if they are so fortunate as to escape doom, like the man in Egypt, do we see them, white-headed, working very strenuously, resolved to sin no more. Life was cheap in the early days of the world, and the ancient engineers, wise though many of them were by virtue of natural wisdom, had good cause to be very circumspect.

Notes and Comments.

Bengal Institution of Engineers.—This well known Institution of Engineers (India) recently paid a visit by invitation to the Bally Bridge. Mr. C. Adams-Williams, Chief Engineer, Irrigation Department, Bengal, also recently delivered a lecture on the Damodar River.

The Mersey Tunnel.—The contract for the work on this new tunnel under the river Mersey at Liverpool has been placed with a Manchester firm. The tunnel on which work has been done to the value of half a million pounds is estimated to cost 1½ million pounds. The work will give employment to 4,000 men, and will take two years to complete.

Assam-Bengal Railway.—The Railway Board have sanctioned the construction by this railway of a metre gauge line 17 miles between Shaistaganj and Balla and another metre gauge line of 23 miles between Chittagong and Nazirhat. The first five miles of the Chittagong-Nazirhat line will be the first five miles of the proposed Indo-Burma Railway that will connect Chittagong with Burma.

Steel Merger.—Two of the greatest steel producing organisations in America, namely, the United States Steel Corporation and the Bethlehem Steel Corporation, have combined their export sales departments in a supreme effort to obtain a larger share of the foreign steel market for which a special organisation has been formed to be called the Steel Export Association and to absorb the export business of both companies.

Longest All-Concrete Road in Britain.—The Enniscorthy-Wexford Road, which is the longest stretch of all-concrete road in the British Isles, being 11¼ miles long, was opened recently by General R. Mulcahy, the Irish Free State Minister of Local Government. This road provides an excellent route for those crossing to Ireland *via* Fishguard and Rosslare who wish to motor from Rosslare to Dublin, and *vice versa*.

Safeguarding London's Roadmen.—At Eastbourne recently, a workman excavating a road struck an electric cable with his pick, causing severe injury to himself, stopping the electric lifts in a neighbouring hotel and putting one of the town's electricity circuits out of action. In Westminster, where extensive relaying of cables is now in progress, concrete slabs are placed over all the cables, thus making such accidents practically impossible.

Cuddalore-Vriddhachalam Railway.—The opening ceremony of this railway was performed on the 21st instant. This railway will link up with Trichinopoly, with a complete grand chord line resulting in reducing the Madras-Talamannar route by 100 miles. Mr. A. N. Kinloch, Chief Engineer, S. I. Railway, after narrating the history of the new line, Mr. Rothera explained that the S. I. R. contemplated the building of a total of 1,300 miles in five years, 220 miles having already been opened and are expecting to open another 250 miles by the end of the year.

Erosion of the Jumna.—The inhabitants of Serajgunge are alarmed at the prospect of the necessity of removing the site of the town owing to the erosion of the river Jumna, and have appealed to the Government, which has decided there is nothing they can do within reasonable expense. An attempt to resist further erosion will be made during the cold weather, and Government have recommended that the situation should be reviewed during the floods.

Beam Service Tests.—Successful experiments have been made by the Government Marconi beam station at Bridgewater, which is the receiving station for the beam telegraph service between Britain and Canada with the new Marconi Mathien Multiplex apparatus. This enables simultaneous telephone and telegraph services to be conducted, and telephone communication was maintained with Montreal at the same time as two Morse telegraph services, all with the same apparatus and aerials. It is considered that the experiments prove an inter-Imperial beam telephone service to be a possibility in the near future.

Calcutta Port Trust.—The financial result of the year 1927-28 has proved more favourable than was anticipated by the Calcutta Port Commissioners when they framed their revised budget estimates. The income amounted to Rs. 3,38,80,000 against an estimated receipt of Rs. 3,30,04,000, and the expenditure to Rs. 3,01,93,000 against an estimate of Rs. 3,05,30,000. It was formerly proposed that after making various adjustments, Rs. 3 lakhs should be transferred to the revenue reserve fund, but in view of the better results it has now been decided to transfer Rs. 16 lakhs to that fund, which will increase it to Rs. 1,31,87,000.

Messrs. Martin and Co.—This well-known firm of engineers of 6 and 7, Clive Street, Calcutta, have announced for the information of their constituents that they have relinquished with effect from 11th June 1928 the managing agency of Messrs. Crompton Parkinson, Ltd., of Chelmsford, England, in the territory comprising Bengal, United Provinces of Agra and Oudh, Nepal, Sikkim, Bhutan, Eastern Bengal and Assam and that part of Central India Agency and Central Provinces east of 80° longitude. Messrs. Martin and Co. are not responsible either for the conduct of the general affairs of this company in the above said territory or for its debts and claims.

Across Syria to Baghdad.—Towards the end of last year the Sunbeam Company had the pleasure of supplying one of their 25 h.-p. six-cylinder touring cars for the use of His Excellency the High Commissioner for Iraq. This car was shipped to the port of Beyrouth, Syria, and disembarked there. Beyrouth is approximately 600 miles from Baghdad, which was the car's destination, and the distance is separated by the twin ranges of mountains, the Lebanon and Ante-Lebanon, and by a tract of the Syrian Desert. Despite the distance and the very rough country encountered, the 600 miles journey was made, including stops, in 26½ hours, the car being driven right through the night. An illustrated brochure dealing with this very

remarkable journey has recently been published by the Sunbeam Motor Car Co., Ltd., and a copy of this will be sent on request to their Export Department at 12, Princes Street, Hanover Square, London, W. 1.

Largest Naval Dock.—The first section of the great Singapore naval dock was towed on the 22nd instant from Wallsend shipyard on the Tyne where it was built, and began the laborious 8,500 miles voyage at the average rate of 3 miles an hour to Singapore. It weighs 12,350 tons, is 178 feet wide, has a draught of seven feet and the sides tower 70 feet above water line. The second section of the dock leaves the following week and expects to catch up with the first at Port Said, where both will pass through the canal together, the difficult process occupying two days. The builders are sending in the dock a party of skilled Tyneside workers and two 5½-ton anchors carried in case bad weather impedes progress. It is hoped to arrive at Singapore in the middle of November. The complete dock will accommodate the largest warship or three destroyers abreast.

Luxurious Mail Steamer.—This P. and O. mail steamer, the "Viceroy of India," will sail from London for Bombay on 28th March 1929. This will be her maiden voyage. The outstanding feature of the vessel will be that single berth cabins will be provided for all 415 first class passengers. Family arrangements will be met by linking up inter-communicating cabins into groups. First class passengers will have five decks connected by twin elevators, a magnificent lounge, a card room, smoking room, Italian verandah, Pompeian swimming bath and two spacious promenade decks. The 250 second class passengers will be provided with a number of single berth cabins, wide public rooms and two promenade decks. The children of each class will have play rooms. The vessel's propulsion is so designed as to eliminate any vibration. She is due to be launched in September.

Ticket Punching Machine.—Mr. A. M. Hayman, O. B. E., Director of Finance, Indian Railway Board, in collaboration with Mr. Mahendra, an engineer with Messrs. Martin and Co., Calcutta, has invented a novel ticket punch which renders ticket frauds on railways impossible. The machine dates and collects tickets into a sealed magazine which can only be opened in the Audit Office where the collected tickets will be fully checked. Another invention recently patented by Mr. Hayman is a ticket-issuing machine which enables blank tickets to be issued by booking clerks, ticket inspectors, etc., but automatically leaves a carbon record behind in a sealed container which could be opened only in the Audit Office. Both these inventions can be carried about in one's pocket and they will be introduced on the East Indian Railway very shortly. The scope of the latter invention is almost unlimited, and can be used in all places wherever an untampered record of money received is essential.

New Mammoth Liner.—The announcement that the White Star Line have placed an order for a new mammoth liner of 60,000 tons gross, marks one more step in the ever-growing competition among the principal passenger steamship lines of the world. The White Star Line was among the first to reorganise after the war in an endeavour to meet competition and they have a steady progressive policy. The new vessel which they have ordered from Messrs. Harland and Wolff of Belfast is 1,000 feet in length and, when completed, will be the largest and most luxurious vessel afloat. It will cost nearly £7,000,000 and will take three years to build. It is to be used on the Company's Transatlantic service. The nearest approach to the vessel in point of size is the British owned "Majestic," a German vessel which was handed over to Britain after the war, re-conditioned and re-modelled, it is at the present day the acme of luxury. It is 915 feet in length and has a beam of 100 feet, the "Leviathan" (U. S.) being the next biggest in point of length—907 feet. Then comes the British owned "Berengaria" of 52,226 tons with a length of 883 feet, followed by the "Olympic," also British owned, having a tonnage of 46,439 and a length of 852 feet. The "Acquitania" though some 1,000 tons smaller in tonnage, is actually 16 feet longer than the "Olympic."

Cauvery-Metur Project.—In connection with the building of the Cauvery-Metur Dam, which will be the biggest dam in the world, the India Office has given Messrs. Hadfields, Ltd., Sheffield, which is believed to be the largest order ever placed for stone breaking and grading machinery. The order comprises three plants each capable of crushing 120 to 150 tons of stone an hour, reducing it from blocks up to a maximum of two tons in weight into the various sizes required for making concrete. The three primary crushers, which have steel jaws measuring 54 inches by 42, will be the largest of their kind ever built in England. There are to be 18 crushers with jaw openings of 24 inches by 13 inches; three of the new 36-inch "disc" crushers; six screens 5 feet in diameter, and various feeders, conveyors, etc. In addition there is a contract covering the electrical equipment. The order is a sequel to the visit to England in 1926 of Mr. W. P. Roberts, one of the engineers of the Madras Irrigation Department, who was considerably impressed by the crushing plant, entirely supplied by Messrs. Hadfields, which was being used on the construction at Pately Bridge, Yorkshire, of a reservoir embankment for the Bradford Waterworks, the largest of the kind in hand at the time. Last year a considerable amount of machinery of Hadfields' make, which had been used for the building of New Delhi, was diverted for work on the Cauvery-Metur Project.

High Praise for Rail Cars.—Unusually high praise from railway officials has been paid to the Diesel-electric rail cars introduced on the Canadian National Railway some two or three years ago. The motive power in these cars is supplied by a moderately high-speed Diesel engine specially designed for the purpose by Willam Beardmore and Co., Ltd., of Glasgow. It is coupled to a generator which supplies electricity to drive the coach by the usual type of electric motors. Thus the car is entirely self-contained. During the last complete year for which figures are available the nine cars introduced in 1925 earned 337,041 dollars (£67,408) in revenue, whilst operating expenses,

INDIAN ENGINEERING.

Addresses and Changes of Addresses.

In requesting change of address give **old** as well as new address and write legibly.

The full and correct address should always be given on **Money-Order Coupons**—see instructions thereon.

including repairs and an allowance for mechanical department supervision, amounted to 127,421 dollars (£25,484), leaving net earnings of 209,620 dollars (£41,924). It is said that on the service between Edmonton, Alberta and Saskatoon, Saskatchewan, on which two of the cars were operated, the working costs as determined by selected accounts averaged 23 cents a train mile, as compared with 1·01 dollar a train mile for steam operation. The saving in operating expense, as compared with the steam train operation on the 120,087 miles per annum covered on this run, is given as 93,677 dollars (£18,735). So impressed are the officials of the Canadian National Railways with the performance of this new-type Diesel-electric car that, in their own words, they "have no hesitation in describing it as the most economical power unit in use on any railway in the world."

The Solution of Many Difficult Transport Problems.—An increasingly popular type of battery-driven vehicle is the small locomotive designed to run on narrow gauge tracks, to work in situations where the room is limited. Messrs. Greenwood and Batley, Ltd., the makers of the well-known "Greenbat" industrial trucks, have developed a range of narrow gauge locomotives, employing either one or two of their special traction type motors, depending on the duty to be performed. The motors derive their power from a battery fitted in two compartments, one at each end of the locomotive, space being provided between the batteries for the driver and control gear. A lever-operated drum type controller gives three speeds in each direction, and also incorporates a cut-out operated by means of a foot pedal, the arrangement being such that, when the pedal is released current is cut off from the motors, and the current cannot be re-established until the pedal is depressed, and the controller handle returned to the off position. The drive is transmitted from the motors to the wheels by means of universal couplings, and enclosed worm reduction gear running in oil, the whole of the drive being enclosed and protected from dirt and wet. The general construction is based on large locomotive practice, and provides a robust and reliable unit. A fleet of nine of these locomotives, made by the Leeds firm, has been employed for some time in connection with the boring of the Mersey Tunnel which is to provide a means of communication between Liverpool and Birkenhead. Conditions of working are far from ideal, but due largely to the drive being entirely enclosed, the locomotives have given every satisfaction. Other similar locomotives are in use in brickyards, limestone mines, and on general haulage work with excellent results.

The New Continent and the Old Car.—"The West Australian," the leading daily of Perth, W. A., recently recounted the history of a voyage without parallel in motor records—a voyage of 2,300 miles across the wilds of Central Australia in a much-handled, but apparently indestructible, 20-year-old British Star car, containing six persons with their worldly gear, their stores and their petrol. A few months ago Messrs. K. C. Taylor-Vernon and R. S. Atkinson decided that they had had enough of Melbourne, and that they would transfer their building business to Perth, on the other side of the continent. Desirous of cutting the cost of transportation, they purchased a 20-year-old Star car for £23 and left Melbourne with full supplies of provisions and petrol. Travelling *via* Port Fairy, Adelaide and Port Augusta, they entered upon the bush country and emerged without mishap at their objective. Barring three punctures, the veteran Star comported itself as if transcontinental ventures over almost trackless wilds were beneath its serious notice. Where a modern picked vehicle might well have started with a full load of spare parts and misgivings, the ancient Star casually commenced and finished its epic voyage without incident. There could be no better advertisement of British engineering quality, and the Transatlantic theory that vehicles from the Old Country are unsuitable for Colonial conditions appears to have again sustained a somewhat serious jar. Where, oh where, is the American car of even four years of age upon which the authors of American car propaganda would care to commit themselves on a similar trip? The incident is truly illuminative of the sound and superb quality of British cars of the Star type. Such vehicles are still being manufactured under exactly the same conditions, but their true worth and their extraordinary value to the dweller in new lands lies buried deep beneath the constant flow of foreign car propaganda.

The Bally Bridge.—At present, owing to the rains, work is confined to piers Nos. 2 and 6. The foundations for the former, which is situated in the main channel, where the depth of water varies from 30 to 45 feet, has already been sunk 65 feet into the bed of the river, leaving another 25 feet still to be sunk. This is being done by means of two 100 cubic feet Bell's dredgers, worked by two 15-ton electric overhead cranes. When a length of 10 feet has been sunk the dredger is stopped, and a further length of 10 feet built up in mass concrete supported by steel shuttering fitted round the outside of the caisson and round the dredging holes. The work on pier No. 6, which is in shallower water, is done by means of a 15-ton electric derrick crane on a pontoon assisted by two 5-ton derrick cranes resting on clumps of timber pile driven into the bed of the river. The foundation for this pier has been sunk 65 feet into the bed leaving 30 feet still to sink. The foundations for piers Nos. 1, 7 and 8 have been completed, and the work in connection with the building of the brick piers is now proceeding. Good progress was made with the approach banks during the dry season, but has now been stopped by the recent heavy rains. The girders for the bridge, which weigh 2,400 tons per span, are being manufactured in India. It is proposed to first erect all the spans on a screw pile staging between piers No. 6 and 7, from where they will be floated out on a staging fitted on two 1,000-ton flats into their various positions. The bridge is being constructed for two tracks of rails with roadways and footpaths on each side. The work is expected to be completed and the bridge ready for opening for traffic at the latter end of 1930. The members of the Bengal Association of the Institution of Engineers (India), who recently visited the works in connection with this bridge, were shown over by Mr. A. H. Johnstone, the Engineer-in-Chief, and his staff of engineers.

Current News.

MR. S. P. FLOWERDEW is confirmed as Chief Engineer, East Indian Railway.

THE Planters' Association of Malaya has decided not to urge further releases of rubber.

THE services of Mr. J. S. Pitkeathly are placed at the disposal of the Government of Ceylon.

MR. W. H. SCOTT is appointed to officiate as Chief Transportation Superintendent, Great Indian Peninsula Railway.

MR. JOHN IZAT, C. I. E., Agent, Assam-Bengal Railway, left for Simla this week to attend the All-India Railway Agents' Conference.

MR. E. INGOLDBY, Deputy Chief Mechanical Engineer, Great Indian Peninsula Railway, is placed on special duty with the Railway Board.

IT is reported that petroleum wells have been discovered at Houdengaimeries, Hainaut, Belgium. The first sounding to depth of 100 feet yielded oozings of decided petrolific character.

THE estimated value of the total primary forest production in Canada for 1926 is dollars 204,436,328, as compared with dollars 209,176,561 for 1925, a decrease of dollars 4,840,233, or 2·3 per cent.

THE keel of a 60,000-ton passenger liner ordered recently by the White Star Line, which will cost nearly £7 millions, is being laid by Messrs. Harland and Wolff at their Belfast yards.

IT is reported from Bogota that the Colombian Government will shortly be in the market for a number of steel railway bridges for lines under construction or to replace existing wooden bridges.

THE Eastern Bengal Railway authorities have decided to open an information bureau shortly. The proposed bureau will be located in the ground floor of their building at No. 3, Koilaghat Street, Calcutta.

TWO new railway tunnels under the Pyrenees are nearing completion. One runs from Bedous to Canfranc, linking Pau with Seville, while the other to the east will connect Toulouse and Barcelona by rail direct.

THE contract for the construction of the North Western Railway bridge over the Indus at Kalabagh has been secured by the All-India Construction Company, a subsidiary of the Tata Construction Company of Bombay.

COMMANDANT GLAIZE, who has been laying the foundations of a commercial air line, from Rangoon to Vinh, has arrived at Marseilles from the Far East. The line will be run in conjunction with the British line from London to Australia.

HEAVY rain in several districts of the Burdwan Division has resulted in the rising of the rivers Damodar, Cossye, Subarnerekh and Ajoy. A breach is reported to have occurred on river Ajoy. At Dhernakhola 17 inches of rain is said to have fallen.

THE extensive works of the Ashbury Railway Carriage and Wagon Co., Ltd., at Openshaw, near Manchester, have been acquired by T. W. Ward, Limited, for dismantling purposes. The works, which were started about 1840, cover a site of about 20 acres.

IN the probable event of the Australian Government abandoning the scheme for a British Empire Exhibition at Sydney in 1930, the N. S. W. Royal Agricultural Society will stage a huge fair at which, it is hoped, the whole Empire will be represented.

THE Government of India have selected a batch of 12 apprentices for training in the mechanical department of the State Railways for appointment to the superior service in that department, under a scheme of training and recruitment. Names will be announced shortly.

ARRANGEMENTS are almost complete in Lahore to begin mechanical railway auditing and the sanction of the Government of India is expected shortly. This new method of checking accounts will be introduced in the Traffic and Audit Office of the North Western Railway.

A ROYAL Commission will inquire into broadcasting throughout Canada, and advise as to its future administration and control. The Government is contemplating control, based on the British system, with public ownership of all broadcasting stations. A sum of 250,000 dollars (£50,000) has been voted for ship-to-shore wireless telegraph stations.

ELECTRICAL Engineers at the summit of Monte Generoso, near Lugano, are investigating the possibility of utilising the electric energy discharged into the air during thunderstorms. By means of special instruments the existence of tensions as as high as 1,700,000 volts have already been registered. During the summer it is hoped to register 6,000,000 volts.

Letters to the Editor.

The Editor desires it to be distinctly understood that he does not hold himself responsible for the opinions expressed by Correspondents.

THE UNIVERSAL P. K. FORMULA.

APPENDIX.

"I. E.," *issue dated 12th May 1928*.

SIR,—The following brief Note seems to be required.

The writer again sees the problem of the tilting cone reported to the Institution of Civil Engineers last year. It is necessary to determine the curved (or *perhaps* straight) line in which the vertex of the cone travels. It is possible that as the point O moves away from the position shown in the figure, the vertex angle of the cone is correspondingly reduced from 153°-26′-6″ to 26°-33′-54″, the slant OA steadily moving up, with A as a fixed point in the same towards the horizontal.

The problem is undoubtedly connected with hydraulic flow; and upon its correct solution rests the hydraulic engineering of the future.

Σ. φ.

4th June 1928.

IRRIGATION IN BENGAL.

SIR,—When the Bengal-Nagpur railway was first opened one of the Engineers on the line received this telegram from a neighbouring Station Master: "Lioness on platform, traffic stopped." Whereupon the following dialogue followed:—

Engineer: "Nonsense Station Master."

Station Master: "Are you looking at the beast or am I?"

Engineer, "But there are no lions here"

Station Master: "I didn't say lion, I said lioness."

It was actually a hyena or leopard, I forget which. This tale came to my mind when I read pages 121 and 122 of Vol. 28, No. 3, of the official Report of the Bengal Legislative Council Proceedings; and in my copy of the Proceedings on page 122 I have written what the Pentonville convict wrote at the end of the Lamentations of the Prophet Jeremiah, "Buck up old chap." The lion which is blocking the way of the overflow irrigation of Bengal is really a lioness.

(1) Training and protective works on the Ganges, with its long and broad sweeps will be anything but costly. The Hardinge bridge protective works were designed against a cyclone. Speaking of the river generally, away from towns and bridges, I consider all stone strewn along banks as thrown away unless it is thoroughly renewed after each flood for five or six years at the least. And then it is not very effective. What is wanted is a series of massive immoveable single spurs of stone *of every size of rock, big and small mixed together*. They should be put up at well chosen sites, and cost between £4,000 and £8,000 a piece, or £6,000 on an average. All to be stone below winter water level; and, in great part, brick kilns over-burnt *in situ*, above winter water level. There are places on the Ganges where a single spur of this kind will keep the current away from the bank for 3 or 4 miles. Pitching slopes is absolute waste of money. Massive single spurs, well tied back, at an angle of 45° to the current and thoroughly renewed for 3 or 4 years will be a permanent landmark on the river.

Once you have fixed massive spurs you can put up powerful pumps on the river and make a garden of the 20 miles inland. For training works no trees surpass acacias, and there is no lack of them on the Ganges.

(2) In my estimate for the Nadia barrage I provided ample provision for training and protective works. I could not do otherwise as I designed the barrage on the bank of the Ganges itself, and kept myself to the point by going out every now and then and having a good look at the magnificent river.

(3) The only new canals to be constructed will be those which will replace old offtakes from the river which have been allowed to be ploughed up. Such expenditure will be confined to a few localities for there are hundreds upon hundreds of miles of existing canals which only need clearance. It is of course assumed that all future encroachments on canals will be prevented.

(4) I see it stated that the proposed Damodar project could be used to feed the Eden Canal. This is moonshine. The Eden Canal has silted up into a watercourse. In its tail reaches, as I saw them, it can only carry one-seventh of the supply it did when it was first dug. The Damodar River itself can however do 10,000 times as much as the Eden Canal can do, whether the canal be left alone or redug; whether it be fed or unfed.

With your permission, Sir, I shall next week show why it is that the Tanjore, Godaveri and Kistna projects have been such successes; and the Orissa, Midnapur, Eden and other Bengal projects been such failures.

W. WILLCOCKS.

CAIRO, *11th June 1928*.

Foreign Notes.

Vehicular Tunnel under the Detroit River.—Final arrangements were completed on 21st May, in New York, for the financing of an important vehicular tunnel under the Detroit River, which will link Canada with the United States of America. The cities on the Canadian side which will be affected by the project, chief of which is the city of Windsor in Ontario, expect that the new facilities for communication with the neighbouring American industrial centres will bring an immediate stimulus to their industries and population.

Proposed Historical Museum of Iron.—Mr. John W. Higgins, president and treasurer, Worcester Pressed Steel Company, Worcester, Mass., intends to found a museum which will be devoted to objects and literature to illustrate the history of iron and steel, particularly sheet iron and steel, from its beginning to the present day. The project has been incorporated in Massachusetts. Plans are being prepared for a museum building 50 by 200 feet, and probably four storeys high, to be erected next year. There will be a library as well as the museum proper.

True Daylight.—According to "Science" north sky light, long accepted as the perfect standard of white light for examining colours, has been found to vary in intensity and colour, not only from day to day, but also from hour to hour. The American Institute of Electrical Engineers reports that north sky light is not white, but blue, and the examination of colours under such light exaggerates blues and minimises reds and yellows. It is claimed that noon sunlight and not north sky light should be accepted as the standard, and that artificial white light for colour discrimination purposes should approximate to noon sunlight.

New Colliery Railway in Alberta.—The Canadian House of Commons has passed a Bill incorporating the Highwood Western Railway, as well as one granting a two-year extension for the construction of a Calgary-Fernie Railway. Provision is made to grant the Highwood Western Railway running rights over the Calgary and Fernie line if built within two years, failing which the former company will be authorised to construct the section. The main purpose of the Highwood Western Railway is to afford access to the Ford coal deposits along the Highwood River. The Calgary and Fernie Railway was also projected to open up coal deposits, known as the Burns coal mine on the Sheep River.

Power from the Sea.—In conjunction with Professor Bouchersot, Mr. Georges Claude, the French scientist whose name is associated with a method of producing synthetic ammonia, hopes that it will be possible to generate power at low cost by utilising the difference of temperature between the surface of the ocean and water at a depth of some 6,000 feet. The Professor has completed tests with a small model turbine, the action of which is based on the above idea. According to the "Daily Mail" the machine was run at 3,000 r. p. m., and a difference of temperature of 7·2 deg. F. was found to be sufficient to actuate it, whereas in the tropics the difference of temperature between the surface and the bottom of the sea is about 36 deg. F. It is stated that a power house is to be built at Havana, Cuba.

Tokyo Subway.—Tokyo, the first city of the Orient to adopt the subway as a means of solving traffic problems, opened the first link of an underground system to the public at the end of December 1927. The enthusiasm of the populace over the inauguration of what was to them a most novel scheme of travel was so great that close to 100,000 passengers crowded the trains and stations on the opening day, and many rode repeatedly back and forth. The new subway connects two thickly populated sections of Tokyo for which surface lines had become inadequate, the terminals being at Ueno and Asakusa. In its construction and equipment, the engineering features and general appearance are very similar to those of the subways of New York City. The excavation was open cut, and roofed over with steel. It is of rectangular section and is situated comparatively near to the surface. The stations, even to the set spaces for advertising on the walls, are like those of New York City, and similar turnstiles of the coin-in-the-slot type are used.

An Electric Public-Clock Installation.—We understand that one of the residents of the city of Valparaiso, Chile, is presenting to his fellow-citizens a 4-foot four-face "Pul-syn-etic" electric clock fitted with striking apparatus. The clock is placed in the central square of the city, on a handsome 30-foot standard, quite close to the railway station, and commanding a very good view. Connected electrically to this clock is a 1 h.-p. motor-driven siren which, by means of a contact maker in the time circuit, sounds automatically at 12 o'clock every day, and by this siren public and business-house clocks all over the city can be kept to uniform and correct time. The master clock itself is in the donor's private house, and with it a model time ball, which is operated by the local observatory, so that the master clock is checked to the second, when necessary. The master apparatus also controls a number of silent interior clocks in the house, and, lastly, a complete set of Westminster chimes, all of which are operated electrically. The whole apparatus has been manufactured entirely by Messrs. Gent and Co., Ltd.

Victorian Railways and Motor Competition.—According to the "Railway Gazette," serving the most compact State in Australia, the Victorian Railways probably suffer more than the other systems from the competition of road motors. This does not apply so much in the Metropolitan area, where a magnificent electric railway service is provided by the Railway Department; but outside that area the receipts from certain classes of railway traffic are steadily declining owing to motor competition. Figures we have recently received from Victoria deal with football traffic and show that during the past three years the number of special trains promoted by various organisations decreased from 906 (118,000 passengers) in 1925 to 855 (100,000 passengers) in 1926 and 729 (76,000 passengers) in 1927. As a result, the revenue from this traffic, which was £30,000 in 1925, dropped to £28,000 the following year and suffered a further decline to £23,000 in 1927. The Railways Commissioners have been giving careful consideration to the question of regaining this traffic and have come to the conclusion that a reduction in fares offers the best prospect. Consequently, fares for special trains run for this traffic during the 1928 football season—now commenced in Australia—have been reduced by approximately 33 per cent. The problem is to increase the volume of traffic sufficiently to cover the cost of the concession.

Railways and Aviation.—The French railway companies have come to the conclusion that the only way to avoid a dangerous competition is to interest themselves directly in all forms of transport. They neglected the inland waterways, which continue to be actively developed and are proving formidable competitors for the conveyance of bulky material. Now they are threatened with even greater competition from road motor vehicles, and with the lessons of the inland waterways in their minds, the companies are examining various proposals for securing a close co-operation between the two means of transport for their common benefit. The idea is to co-ordinate all the different services, so that while developing transport, they will bring traffic to each other. The companies are even taking a lead in the creation of new air services, and were responsible for the formation of a committee which is carrying out preliminary arrangements for establishing an air line between Geneva, Lyons and Bordeaux. At the invitation of the Chamber of Commerce of Lyons a number of representatives of the Swiss and French Governments, railway companies, commercial bodies and others visited that town in order to discuss details, and it was stated that next year the air station to be constructed at the Bron aerodrome, at Lyons, for the Geneva-Lyons-Bordeaux service will be one of the largest and best equipped in Europe. The railway companies were complimented on their enterprise in financially assisting the new air service.

Locomotive Orders in America.—An interesting survey of the orders placed during 1927 in the United States for locomotives and rail motor cars appeared in a recent issue of our American contemporary, "Railway Mechanical Engineer," says the "Railway Gazette." It is stated that the past few years have seen more railways ordering locomotives that can be used in both services, *i. e.*, passenger and freight. This was particularly noticeable in 1927, and is due primarily to two developments, one being the demand for faster freight-train speeds, which in many cases nowadays approach the passenger train schedules, and secondly, the development of the booster. A large percentage of the locomotives ordered last year for service on U. S. railways are equipped with boosters, and there is a growing tendency to use this appliance in conjunction with four-wheeled trailing bogie trucks. The past year has shown a trend towards higher steam pressures, and locomotive boilers and auxiliaries such as pumps and other appliances are being operated with superheated steam. The number of new locomotives ordered in 1927 was smaller than in 1926, the figures being 734 last year as against 1,301 in the previous one, these figures relating to locomotives intended for use in the country of origin, and not including any built for service abroad. On the other hand, the orders for rail motor cars showed an increase, the total being 201 cars with internal-combustion engines, of which 180 were for service in the United States.

Aluminium Powder.—According to the "Chemical Trade Journal and Chemical Engineer," aluminium powder, erroneously called aluminium bronze in the United States, is acquiring an ever-increasing industrial importance. There is only one method available for its satisfactory production, and that is to submit the metal to pressure in such a way that it is divided into very small pieces which have the shape of spangles or shining platelets. By this process a polishing effect is also imparted, to which the metal owes its lustre. If direct grinding methods are employed, a powder is obtained which is by no means so lustrous as the spangles, so that any direct grinding action should be avoided. The metal is usually hammered in specially constructed stamp mills. The aluminium must be pure—99 per cent. and over. Impurities, such as iron and silicon, make it hard and unsuitable for treatment in the stamp mills. In addition, these metals form alloys with aluminium which are coloured blue and grey, and so detract from the lustre of the powder. In the hammering process it is readily intelligible that the minute spangles receive lines and other impressions from the machinery, but it is precisely these irregularities on the surface of the spangles which contribute to their intensified reflexion of incident light, and so to the lustre of the powder. The thickness of the spangles varies between a fourth and a five hundredth part of a millimetre, and the ratio which the diameter bears to the thickness varies between 200 : 1 in the case of good quality powders to 5 : 1 in the case of poor quality powders. The tougher the spangles the better the quality of the material, and this toughness is largely dependent upon the purity of the metal used.

The Avonmouth Dock Extension.—According to the "Engineer" on 23rd May the extension of the Royal Edward Dock at Avonmouth, which has been in the making for the past four years, was opened by H. R. H. the Prince of Wales, in the presence of a great gathering of people. Almost twenty years ago the Prince's grandfather, the late King Edward VII., performed a similar ceremony when the dock which bears his name was completed. That dock, as it then existed, was a very costly work, having regard to the comparatively small water space and quayage accommodation which it afforded. It had, however, always been intended to construct two arms or branch docks at the northern end of the dook and in that way to double its water area and more than double its extent of quayage. The original plans of the Royal Edward Dock indeed provided for these branches. One of these arms—the northern—was dredged out some years ago, and is now utilised as an oil basin; the other—the eastern arm—which has now been opened has a water area of over 15 acres and contains 3,600 feet of quayage, just about as much as the original dock possessed. The accommodation provided by these arms redresses to some extent the uneconomical balance between the cost of capital works on the one hand and the provision of traffic facilities on the other hand which was exhibited by the original dock. The works in the new arm are of strikingly economical design, and this comment applies not only to the wharf structures, but also to the grain-handling appliances and transit sheds, which have been provided in connection with the extension. Although primarily intended for grain import trade the arm is well equipped for general cargo handling, and the transit sheds as well as the very interesting grain equipment are examples of the best modern practice.

General Articles.

NEW MIKADO (2-8-2) TYPE LOCOMOTIVES FOR THE ANTOFAGASTA (CHILI) AND BOLIVIA RAILWAY.

OUR contemporary, the "Railway Gazette," illustrate the photograph on the opposite page, by courtesy of the builders, Beyer, Peacock and Co., Ltd., Gorton, Manchester, one of three 2-8-2 type locomotives with eight-wheeled tenders recently constructed by them for the Antofagasta (Chili) and Bolivia Railway for working on the Chilean Northern Section, of which Mr. H. R. Hood is the Chief Mechanical Engineer, with headquarters at Mejillones.

Whilst there is nothing particularly noteworthy about the engine as regards wheel and cylinder arrangement and other general features, the complete nature of the equipment is certainly worthy of mention says our contemporary. This includes the Superheater Company's apparatus with the regulator placed outside the smokebox on the superheated steam side of the header and operated by lever and sector attached to the cab roof. The Worthington feed-water heating system is fitted, the feed heater being of the Worthington-Simpson open type, whilst the main stop valve in front of the dome is of the Hopkinson-Ferranti type. The feed water is delivered to the boiler through a top feed device fitted with a spraying arrangement. In addition, there is one Friedmann No. 9 injector.

Westinghouse brake mechanism is applied to the engine and Westinghouse and hand screw brake on the tender. The axle-boxes are lubricated by a Wakefield mechanical lubricator, and the same firm's Eureka lubricator is employed for the cylinders and steam chests. Other equipment comprises Henricot automatic couplers, Coale's muffled pop safety valves, a Gollmar bell ringer, and Pyle electric lighting. The connecting and coupling rods are made of carbon vanadium steel, and, in addition to the above items, one engine is fitted with indicator gear.

The cylinders, as seen, are placed outside the frames with their piston valve steam chests above them, the drive being to the third pair of coupled wheels. The boiler mountings occupy practically the whole of the space between the chimney and the cab, these including two cylindrical sand boxes placed one on either side of the steam dome, on the latter being mounted the Coale pop safety valves. Other fittings consist of the outside regulator casing and stop valve, the top feed device, bell and motor for supplying current or the electric headlight.

The disposition of the Westinghouse and Worthington pumps, one on either side of the boiler, is shown in the photographic illustration.

The principal particulars are as follow :—

Gauge	... ...	Metre.
Cylinders—		
Diameter	... ...	19 ins.
Piston stroke...	...	24 „
Wheels, coupled, diameter...		3 ft. 8 ins.
Wheelbase—		
Engine	... ...	26 „ 9 „
Rigid	... ...	11 „ 9 „
Boiler, working pressure	...	150 lb. per. sq. in.
Heating surface—		
Tubes	... ...	1,600 sq. ft.
Firebox	... ...	94 „ „
Total	...	1,694 „ „
Superheater	... ...	366 „ „
Combined total	...	2,060 „ „
Grate area	... ...	29·7 „ „

The engine develops a tractive effort at 75 per cent. of the boiler pressure of 22,160 lb.

The tender is supported upon two four-wheeled bogies with outside bar framing. It is equipped for the conveyance of liquid fuel, and carries 8,000 litres of oil, the water capacity being 4,200 U. S. gallons. The engine in working order weighs 60 tons 15 cwt., and the tender, 45 tons 10 cwt., giving a total, loaded, of 106 tons 5 cwt., the maximum axle load being 11 tons.

A system of spring compensation is included in the design of this locomotive, the arrangement being that the front truck and leading coupled wheels are arranged in one group, and the intermediate, driving, trailing and hind truck wheels in a second group. The radial arm of the hind truck acts as a compensating beam, the weight of the rear end of the engine being taken by the sliding supports, which can be seen under the side frames in front of the trailing bogie wheels.

SIR WILLIAM WILLCOCKS AND IRRIGATION IN BENGAL.

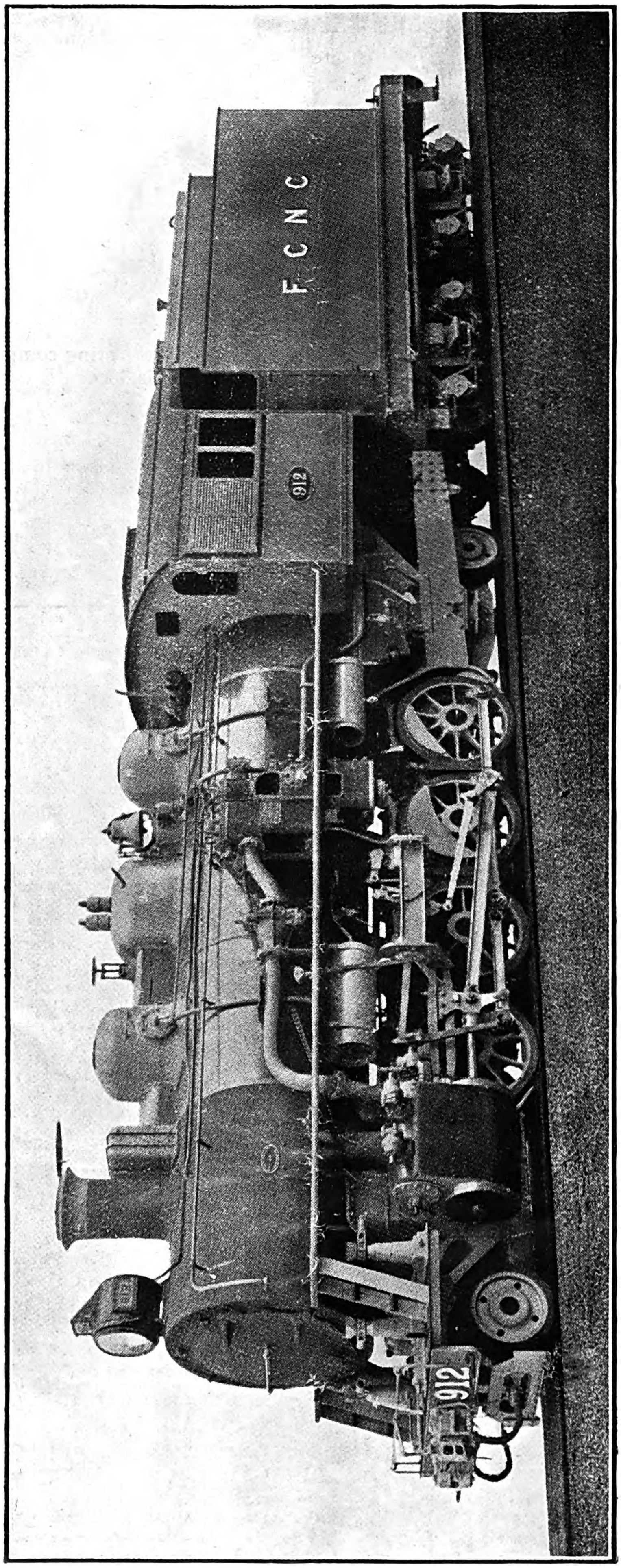
BY W. A. INGLIS.

I.

THE lecture delivered in the British India Association Hall by Sir William Willcocks, on the 6th March 1928, entitled "The Restoration of the Ancient Irrigation of Bengal," is of great interest to those who have had some experience of the practical difficulties encountered in dealing with the rivers in that Province.

The first question that naturally suggests itself is whether there ever was in the past a system of irrigation, and if so what was the nature of the system? Sir William says "it was to make full use of the rich red water of the Ganges flood and the abundant but poor water of the monsoon rainfall that some great ruler of ancient Bengal thought out and put in practice the system of 'overflow irrigation' of the Ganges delta which insured health and wealth to Bengal for thousands of years." These are fine words, but can Sir William, or anyone else, know what was happening even one thousand years ago and whether there ever was such health and wealth. Sir William does not specify what he exactly means by the term "overflow irrigation." It apparently means the uncontrolled inundation caused by the passage of flood water over the natural banks of the river. This can hardly be termed irrigation since that word is usually understood to mean the application of water to land by means of artificial works. In Chambers' Twentieth Century Dictionary the word "Irrigation" is defined thus :—"A method of producing or increasing fertility in soils by an artificial supply of water, or by inundating them at stated periods : act of watering, especially of watering lands artificially."

In the Gangetic delta there are, as is usually the case in deltaic areas, numerous channels which originate as effluents or spill channels from the main stream. They are not rivers in the ordinary sense of the term. That is they often run at a comparatively high level and do



NEW MIKADO (2-8-2) TYPE LOCOMOTIVE FOR THE ANTOFAGASTA (CHILI) AND BOLIVIA RAILWAY.

not receive local drainage. In the course of time, to be reckoned by centuries rather than by years, when the land building of a part of the delta has reached a certain point, the main stream passes to a less developed part and the effluents, by natural action, close up near the offtake partially or completely. In other cases the heads of the effluents may have been closed by artificial works constructed to give protection to certain tracts of land from flood inundation.

Sir William calls these channels canals. In a somewhat loose use of the term some of them might be called "natural canals" since, as they run at a comparatively high level, it may be possible to make use of them for irrigation. They are, however, wasteful as carriers of water and purely artificial canals are preferable. Sir William asserts that many of these channels were artificially constructed with the object of leading the flood water over the country. As there is no reliable evidence it is not possible to come to any conclusion and it is useless to argue the point. It seems, however, fairly certain that there never were any works by means of which the flood water could have been controlled or regulated.

I therefore hold that there is nothing to prove that there ever was any irrigation in the proper sense of the term. There was, no doubt, a greater extent of uncontrolled inundation and it is an open question whether this inundation was, on the whole, favourable to the fertility of the soil or otherwise.

As regards health, it is, I think, now generally admitted that the inundation is favourable.

What may have happened in the remote past is, however, only of historical interest. The important question is what line of action should be adopted in the future. The diminution in the flood inundation in Central Bengal is to a considerable extent due to the construction of marginal flood banks. Sir William advocates the construction of permanent openings or sluices in the marginal banks by means of which certain controlled volumes of flood water may be admitted. In this, as a matter of principle, I quite agree, but before any specific proposals can be put forward many enquiries have to be made, and above all it is necessary that the views of those directly interested in the cultivation of the land should be ascertained.

MACHINERY AT THE PARIS FAIR.

THE site of about 100 acres which has been laid out at the Porte de Versailles, Paris, for the holding of exhibitions is admirably suited for that purpose, but it has become far too small for the annual Paris Fair, and unless it be possible to extend the area considerably, it is difficult to see how the Paris gathering can vie in importance with some of the Fairs held abroad. Starting as a national show of "samples," the Paris Fair has grown rapidly since it was given an international character, and in view of its success, efforts are being made to secure for it a leading position amongst the great industrial and commercial gatherings of the world. At the recent Fair there were more than 7,000 exhibitors, and thirty countries were said to be represented.

An attempt was made this year to give greater importance to the machinery section. A vast hall was devoted both to mechanical and electrical engineering, but, as a matter of fact, the machinery exhibits occupied a comparatively small area, for they were largely crowded out by the considerable number of small stands. That is to be regretted, for many foreign machinery makers are aware that the Paris gathering offers them the only means of bringing their specialities directly before buyers. There is no other machinery exhibition in France, and the Fair is remarkably interesting as a whole. It attracts vast crowds of visitors, amongst whom is a large number of prospective buyers of machinery. Paris is one of the largest industrial centres in the country, if not the largest, and utilises probably more machinery than any other. The Fair, therefore, offers an opportunity to introduce into France anything which may appeal directly to French users.

French machinery makers for a long time hesitated to support a Fair which appeared to be of too general a character, but this year the stands were much more numerous and interesting than before. A second hall had to be devoted to overflow exhibits. The great bulk of them were machine tools. French firms are making great efforts to emerge successfully from the crisis through which the machine tool industry has been passing. They are expanding their production and bringing the machines more up to date, while some of them have gone in for the manufacture of heavy high duty lathes, boring machines and milling machines. The Etablissements P. Huré, which have long been identified with small universal milling machines, showed much larger sizes, and the universal milling head they introduced has become so popular that other makers have adopted the same principle, notably S. O. M. U. A., which showed a heavy milling machine with a combination of horizontal cutter arbor and rotating head carrying a vertical cutter spindle. For vertical milling the horizontal spindle is removed and the head is turned round for cutting to any angle. The head contains gear which meshes into the driving gear when bolted to the machine in the required position. S. O. M. U. A. represents the initials of the company formed by the Schneider group which absorbed a number of machine tool firms in the Paris district, and has developed considerably the construction of the heavier classes of machine tools. The group showed a high duty semi-automatic lathe with a novel form of turret that ensures a rapid adjustment and clamping of tools. Cuttat et Cie were the first in France to specialise in small automatic lathes, and they have continued to increase sizes until they were able to show at the Fair an automatic lathe for taking 3½-inch bars. Other French firms exhibited automatic lathes, but it cannot be said that this branch of the industry has developed sufficiently for the home needs. Foreign automatic lathes will continue to find favour in France. In the heavier machine tools French makers will probably be more successful, for many of the machines shown were of good design and well built, and the import duties give a great advantage to the home manufacturers. Nevertheless, there are special machines which the French do not produce, although there was evidence of plenty of invention, and one firm showed what was apparently an experimental model of a gear-cutting machine which, it was claimed, needed no special adjustment for the work to be done. Powerful vertical milling machines were exhibited by Gambin et Cie, and heavy boring machines was shown by Sculfort-Fockedey, Vautier et Cie, of Maubeuge. This latter concern is an amalgamation of the machine-tool firms which, before the war, enjoyed the reputation of turning out cheap yet reliable machines, not remarkable for finish, but the reconstruction of the Maubeuge works since the war has been accompanied by improved designs and manufacture, and the Maubeuge productions are now far in advance of their old reputation. There is a predilection amongst the French for combined machines, several of which was exhibited, particularly combined boring and milling machines. A characteristic example was the universal machine of the Etablissements E. Cornac, of Castres (Tarn), which is provided with table and headstock and special belt drive for multiple speeds, allowing for all kinds of adjustments for boring, turning, milling and screw cutting. Other firms showed heavy vertical lathes, boring and milling machines of quite creditable construction.

Notwithstanding the progress made by French firms in the design and construction of machine tools, there is plenty of scope for foreign makers who can offer machines satisfying the special requirements of users. After passing through a very critical period manufacturers are paying far more attention than formerly to the problem of getting down production costs, and there is a good opening now for machines which can be proved to cheapen output. American machines were represented by agents, and the only British stand of machine tools was that of the Société Anonyme Alfred Herbert, on which some automatic lathes and cylinder-grinding machines were shown in action. Other British goods exhibited were the automatic weighing machines of W. and T. Avery, Ltd., and S. Denison and Son, Ltd., which were represented by the Société des Bascules et Balances. The almost universal use of British automatic weighing machines in the large stores and shops in France shows that business can be done in machines fulfilling special need. A feature of the machinery section was the participation of the Germans, who appealed more particularly to the prevailing interest in the economy of grinding and heavy machining. There were several types of German grinding machines, from that shown by the Schiess-Defries A. G., of Dusseldorf, for grinding tools to any profile at the rate of sixty an hour, to the machine for grinding rolls, the latter being shown in operation by H. A. Waldrich, of Siegen. There were German gear cutting machines and semi-automatic lathes, and in the Machinery Hall the participation of Germany was larger than that of any other foreign country. It is worth recording that not only in machine tools but also in other classes of machines German makers were largely represented.

More prominence was given to printing machinery than in former years, and in this branch also French makers are extending their field of activities, several small firms having laid themselves out of late years for a largely increased production. Apart from Marinoni, which is the oldest and most important firm of manufacturers of rotary printing machines in France, there are several makers whose production is quite large. Type-setting machinery was represented by the Linotype and Machinery Company, Ltd. Here again German makers showed up prominently with printing machinery, either offering special features or else designed for accelerated working and increased output. The German claims are invariably based upon a cheaper and heavier production, and appeal to the French at a time when industry is still in a state of transformation. The biggest installation of printing machinery in the hall was the German Planeta machine. Amongst specialities may be mentioned a new German process for making blocks direct from the drawing in less than twenty minutes. The drawing is photographed on to the zinc plate, is wiped over by hand with three different chemical products, and a block which can be printed from immediately is produced. The process and the printing machine are intended for public and other services which require to print notices, circulars, drawing, etc., from the originals. The machine is known as the Schwartzpress.

The electrical section was devoted largely to the application of electricity to domestic and, to a less extent, industrial purposes. Most of the electrical engineering companies had exhibits, but they were mainly products interesting the public user, and they were more in keeping with the character of the Fair. The efforts to popularise the use of electricity for other than lighting purposes have not been entirely successful. The cost of electricity is generally too high, and despite the propaganda in favour of cheap current from hydro-electric power plants, the electrification programme has not yet been so successful as had been anticipated. Nevertheless, the use of electrical energy is extending, particularly in workshops, and amongst the exhibits small motors for actuating tools were conspicuous. Electric welding is also being used increasingly for all purposes, and several companies are now specialising in electric-welding plants.

Besides the vast Machinery Hall there was a number of buildings devoted to various industries, and streets of wooden shops, divided into sections covering every branch of industrial activity were laid out. Some of these wooden buildings were occupied as offices by the British Chamber of Commerce in Paris, and were available for visitors interested in British machinery. Outside, in the grounds, were installed the heavier classes of machinery, such as forging, stamping and pressing machines, the most powerful of them being of German manufacture. The Germans usually presented machines of greater power than those produced in France. Oil engines continue to be regarded as the most adaptable type of prime mover for rail motors, both for the railways and for public works contractors, and for the latter purpose a narrow gauge locomotive was shown with oil engine and electric transmission. On the railways it is proposed to fit engines of increasing powers to rail motors, but this involves difficulties with the use of gears for changing speeds, and efforts are being made to suppress sliding gears without the intervention of electric transmission. Petrol road rollers, large numbers of which are in use and appear to be giving satisfaction, were also exhibited. In oil engines the British industry was represented by Ruston and Hornsby, whose productions enjoy the highest reputation in France. Considerable prominence was given to sawing and wood-working machinery. Practically every machine of this kind is manufactured in France, some firms, like Guilliet, Fils et Cie, of Auxerre, having a considerable production. Panhard and Levassor have continued to develop their wood-working machinery branch, and, since the war, the Société des Moteurs Salmson has extended considerably the manufacture of such machines. Machinery for public works contractors offers another wide scope for business, and American firms started early with concrete-mixing machines and steam shovels, which were again exhibited at the Fair, although much of the concrete mixing machinery is now manufactured in France. Into one American power shovel was fitted a Ford petrol motor unit. British manufacturers will find that there is still business to be done in France in reasonably priced machines offering advantages in the saving of labour, says the "Engineer."

PRINCIPLES OF ROADMAKING.

By G. C. BANERJEE, Late Executive Engineer, P. W. D., Bengal, Consulting Engineer, Alipore, Calcutta.

SECTION II.

In the preceding section the resistance of the wheel carriages on level parts of roads was discussed on the basis of General Morin's formula which is generally accepted. The recent experiments of M. Dupuit show that :—

(1) The resistance to traction is directly proportional to the load.

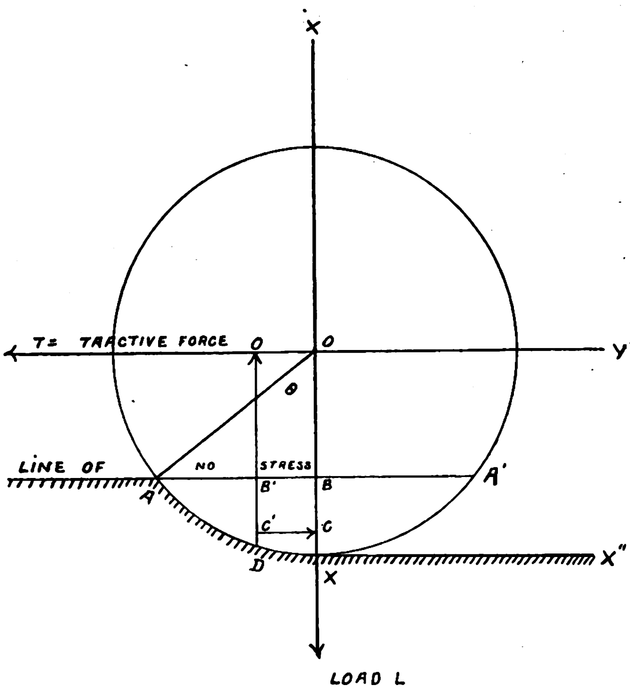
(2) It is independent of the width of the tyre.

(3) It is inversely as the square root of the *diameter*.

(4) It is independent of the *speed*.

But M. Dupuit admits that in paved roads which give rise to constant concussion the resistance increases with the speed whilst it is diminished by an enlargement of the tyres up to a certain limit.

DIAGRAM OF FORCES ACTING UPON A WHEEL.



(1) It will be seen on comparison that the experiments of M. Dupuit only confirm the results obtained by General Morin and there is no difference between the results of the two sets of experiments as to the fact that the resistance to traction is directly proportional to the load. With the enlargement of tyres the load per unit area decreases and consequently the resistance diminishes but the limit up to which the law of diminution holds good will be shown later on.

(2) From a study of the effect of *extent of surface on the coefficient of friction* and it observed that the *coefficient of friction is rather less for small rubbing surfaces, that is to say, the coefficient of friction diminishes as the pressure per square inch rises.* The law that friction is independent of the *extent of the surface in contact is not absolute but it is only approximately true.* It is also well known that the value of the *coefficient of friction* depends upon the *nature of the materials* and the *state of the surface in contact.* The vehicular traffic which ply on roads as classified in Section I may be distinguished as having either (1) Narrow hard and (2) Soft wider tyres. Narrow hard tyres destroy the road by friction, shock and load concentration whilst with soft wider tyres the pressure per square inch diminishes and although they have not the same tendency of narrow hard tyres to abrade the surface of the road still they destroy the road by suction, sweeping and producing a polishing effect.

(3) It appears from the result of experiment of M. Dupuit that the resistance to traction is *inversely proportional to the square root of the diameter* as against the *radius of the wheel* given by General Morin. In practice the diameters of wheels varies from 2′-6″ to 6′-0″ and the radii and the square roots of these diameters are as given below :—

Diameter of wheels.	Radius.	Square roots of diameter.
2′-6″	1·25	1·60
3′-0″	1·50	1·73
4′-0″	2·00	2·00
5′-0″	2·50	2·24
6′-0″	3·00	2·45

It would be seen on reference to the table above that for wheels with diameter of 4′-0″ the square root is equal to the radius, for diameters less than 4′-0″ the square root is greater than the radius, and for diameters greater than 4′-0″ the square root is less than the radius. Further, the increase and decrease in the square roots of diameters on either side of four being practically the same it is quite apparent that the mean value of the resistance of wheels of different diameters on level parts of roads would be the same as for a diameter of four feet, and this being the case it is immaterial whether the resistance is taken to vary inversely as either as the radius or the square roots of the diameter.

General investigation on tractive force on roads of soft homogeneous material such as earth, etc., from the analysis of forces :—

When a carriage-wheel rolls on a road the crust or the surface layer of which is made of soft homogeneous materials such as earth, sand and so on, a portion of the wheel such as AX as shown in the figure, gets indented into the road leaving a track XX″ behind. Let BX be the depth of immersion of the wheel at X.

The forces which act upon the wheels are :—

(1) The tractive force (T) whose line of action passes horizontally through the centre of the wheel.

(2) The load (L) which consists of the weight of the wheel and the load upon it acting vertically downwards through its centre.

(3) The resistance of the road medium on the submerged portion ADX of the circumference of the wheel in advance of the perpendicular line drawn from the centre of the wheel (O) to the plane of the road. Supposing the road to be made up of homogeneous material such as earth the resistance distributed over the surface ADX may be taken to consist of a pair of *confugate pressures*, one vertical and the other horizontal. The vertical pressure is the same as the resistance to penetration of the wheel into the road material and is an uniformly varying stress whose intensity at a given point varies as the distance of that point from the given horizontal plane ABA′ that is to say, is proportional to the depth of immersion which has its maximum value at X and gradually diminishes till it disappears at A. The line ABA′ therefore represents the *line of no stress.* If the depth of immersion BX at X is denoted by "d" then the resultant of the stress (p) acting on the surface ADX may in symbols be expressed by the equation

$$P = a\int_{0}^{d} xydx$$ where "a" is a constant coefficient and may be taken as acting vertically, that is perpendicularly to the plane of the road. As the vertical pressure increases with the depth of penetration it is of the nature of fluid pressure and the depth of the centre of pressure is two-thirds the total depth of penetration, that is $\frac{2}{3}BX = BC$. Further the area of the submerged portion being small the centre of gravity of the half segment ABX and the centre of pressure may be taken as coincident points. If Θ be the angle which the arc ADX subtends at the centre and "r" the radius of the wheel then the distance of the centre of gravity of the half segment ABX from the centre line XOX′ is given by the expression

$$Y_0 = \frac{1}{3} r \times \frac{4 \sin^3 \frac{\Theta}{2} - \sin^3 \Theta \cos \Theta}{3(\Theta - \sin \Theta \cos \Theta)}$$

But Θ is small

therefore $\sin \Theta = \Theta$

Therefore $Y_0 = \frac{1}{3} r\,\Theta$, that is to say the centre of gravity lies at a distance of one-third the length of the arc ADX that is DX from the line XOX′ which for all practical purposes may be taken to be equal to CC′.

Therefore taking moments about C′

$$T \times C'O' = L \times CC'.$$

$$\text{Or } T = L \times \frac{CC'}{C'O'}$$

$$\text{But } CC' = BB' = \frac{1}{3} AB$$

$$\text{and } C'O' = OC$$

$$= r \text{ (practically)}$$

$$\text{Therefore } T = \frac{AB}{3} \times \frac{L}{r}.$$

That is to say, *the tractive force is directly proportional to the load and inversely proportional to the radius of the wheel.*

(To be continued.)

FIRST IN THE FIELD.

THE circumstances under which the names "Dennis" and "London" are linked together by the word "first" are to no small degree significant. Some of the most important occasions may be briefly detailed as follows:—

1904. A Dennis was the first 'bus embodying the worm drive to be put into service in London. In the face of severe criticism, the firm persisted with the development of this form of final drive, and to-day it is found on every 'bus operating in the metropolitan area, an ample vindication of the early optimism.

1910. A Dennis was the first turbine motor fire engine ordered by the London County Council, all the engines hitherto used by the London Fire Brigade having been fitted with pumps of the reciprocating pattern. So impressed were the Authorities with the performance of the new type that their initial order was for seven machines.

1914-5. A Dennis was the first London motor fire tender to be equipped with a separate pump for the first aid apparatus. The latter, it may be mentioned, is a small hose which is fed from a tank of water carried on the vehicle, and therefore available the moment the latter arrives on the scene of action, as there is no need to connect up with a hydrant. Prior to this date, cylinders of compressed gas were used to force the water through the first aid hose, not a very satisfactory arrangement, as the stream had to be interrupted owing to the refilling of the tank, and the supply of gas was very limited. Under present conditions, the small pump that weighs but a few pounds can be used continuously while the tank supply is maintained.

1925. A Dennis was the first 'bus shod with pneumatic tyres to be passed by the Scotland Yard Authorities for general service in London. It is, perhaps, hardly necessary to add that the Authorities, having full responsibility for the organising of the Metropolitan traffic, are at pains to satisfy themselves that any such innovation will not merely benefit the passengers of the vehicle so equipped, but that no inconvenience or danger shall threaten other road-users. Many other pneumatic-tyred 'buses have now joined the pioneer, and the majority of them have issued from the Dennis factory.

1926. A Dennis was the first 'bus fitted with 4-wheel brakes to be approved for London service. This innovation was not brought about without proof positive that skidding was definitely eliminated from the capabilities of the Dennis E. Type chassis (a forward-control, low-load-line model fitted with 4-wheel servo-operated brakes). Tests of the most spectacular nature were carried out on a smooth concrete floor, treacherously flooded with soft soap, in spite of which the machine manœuvred perfectly, and thus became the forerunner of the many Dennis 4-wheel-braked 'buses now operating in London.

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The foregoing extracts from the history of Messrs. Dennis Bros., of Guildford, England, explain, in a measure, their outstanding position in the motor manufacturing world. They are not only the oldest commercial motor manufacturers in the British Empire, but they have given by far the most satisfactory results to their shareholders. It is only fitting that as a recognition of their pre-eminence amongst British motor manufacturers that they are holders of a Royal Warrant of Appointment as Motor Lorry Manufacturers to His Majesty the King.

The Gazettes.

Burma, June 7, 1928.

Buildings and Roads Branch.

Leave on average pay for three months is granted to Mr. C. S. Sahny, Assistant Engineer, Sandoway Division, with effect from 29th March 1928.

Leave on average pay for one month is granted to Mr. S. M. Gupta, Assistant Engineer, Pegu Division, in extension of the leave granted him previously.

The undermentioned students who have graduated in Engineering from the University College, Rangoon, are appointed as Apprentice Engineers, for a period of one year, with effect from 1st June 1928, and are posted to the circles, as noted against each, for practical training. They will draw a subsistence allowance of Rs. 150 per mensem each during their practical training :—

(1) Maung Aung Tun—Pegu Circle.
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Irrigation Branch.

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Punjab, June 22, 1928.

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Date Due

Engr